IRON AND STEEL

JOHN F. KELLY, Editor

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VOLUME XI SEPTEMBER, 1934

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Developments In The Iron and Steel Industry 1933-1934

By WALTER H. BURR
Chairman, A. I. & S. E. E. Development Committee and Mechanical and Electrical Superintendent, Lukens Steel Co., Coatesville, Pa.

Paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

Inventions increase and new developments are promoted during periods of depression. Throughout this economic crisis our laboratories and research departments have shown results such as were never known before. Our transportation equipment is rapidly undergoing changes which call for greater speed, increased comfort and all at a reduced cost.

WALTER H. BURR

Modern motor cars utilize as many as sixty different alloys. These new materials are constantly being developed and new processes employed. In many homes comforts are enjoyed which, when more generally adopted, will provide new outlets for the products of our mills and factories. Only by continuing in this research work and the development of new processes and products can we, as a nation, continue to prosper and enjoy this high degree of civilization.

In the steel industry new finishing capacity for sheet and strip mills represents the major portion of all the new equipment which has been installed or considered since the Steel Code went into effect in August of last year. If these installations are all carried out they will add approximately 5,000,000 tons to the annual rolling capacity of this country. All this investment is being made when an increase in pig iron and open hearth steel making capacity is prohibited.

MAIN ROLL DRIVES

Strip Cold Rolling

During the year 1933 activity in the installation of new rolling mills was confined very largely to units for strip cold rolling. The demand for tin plate for food and other containers has continued in almost as great volume as during more prosperous years, and the demand for wider and heavier gauge flat products, used largely by the automobile industry, has also been sustained well above the demand for most other steel products. Improvements in the design and method of operation of mill equipment have shown the cold rolling process as being economical and capable of producing high quality strip in light gauges and relatively narrow widths for tin plate, and in heavier gauges and greater widths for automobile fenders and bodies, and other uses. With the continued demand for these flat strip products, and greater economy and improved quality, it is but natural that several cold roll strip mills have been installed to supplement or replace existing hot sheet and tin plate mills.

Three of the tin strip mills are of the single stand, reversible type, with two tension reels located one at each side of the roll stand. The mill and reels are reversible, and the strip is passed back and forth through the mill, being unwound from one reel and rewound on the other reel, for as many passes as necessary to effect the desired total reduction. Reductions in thickness as great as 50% per pass can be taken, and the mills operate at rolling speeds 1000 RPM. or higher during the longer finishing passes. On each of two mills, the mill rolls are driven by a 1200 HP. direct current reversible motor, and each of the reels is driven by a 500 HP. motor. The mill rolls on another mill are driven by a 2000 HP. direct current motor, and each of the reels by a 600 HP. motor. Special variable voltage control is used to assure smooth acceleration and deceleration, and the operation of the reel motors is accurately controlled by load regulators to maintain constant tension.

There has also been installed an 84" single stand reversible mill and reels, to roll sheet gauge strip up to about 76" wide, using a 1500 HP. motor to drive the mill rolls and two 700 HP. motors to drive the tension reels. The rolling speed is relatively much lower than on mills rolling strip for tinning, and the tension reels and their drives have capacity to develop strip tension as great as 100,000 pounds.

One of the most recent tandem mills, which it is understood will be used for rolling tin plate, has five stands in tandem with a tension reel. This seems to be rather a radical shift from the tendency to decrease the number of stands in tandem which has been apparent for the past two years. Several years ago it was common to have four stands in tandem for cold strip rolling. Within the past two or three years many mills having only two or three stands in tandem have been installed.

This year, in addition to the 5-stand mill mentioned, a 4-stand mill has also been purchased. The 5-stand mill is very heavily powered, the first and last stands have a 500 HP. 400/800 RPM. motor, and the three middle stands each having a 750 HP.

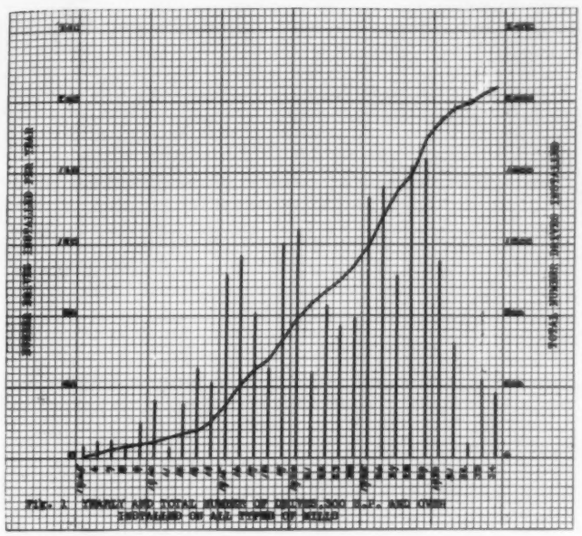

FIG. 1.

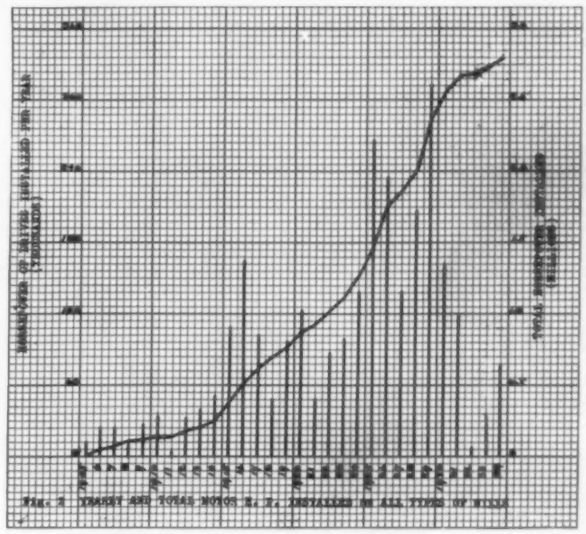

FIG. 2.

225/900 RPM. drive. Power for this mill is supplied by an individual 2500 KW. motor-generator set, and the adjustable voltage method of starting, stopping and speed control. is used.

Hot Strip

Since the first of the year 1934 the interest in Hot strip mill for production of plate, wide strip for automobile sheets and strip for cold rolling to tin plate gauges has been most unusual. One of the outstanding installations is that being built for the Ford Motor Company. A blooming mill driven by a 7000 HP. DC. 750 V. 40/120 RPM. reversing motor is to be installed. The electrical equipment required for driving this 4 High hot strip mill, as reported, will consist of the following motors:

1— 800 HP. 600 RPM. 440 Volt AC. Motor
1—2500 HP. 600 RPM. 13200 Volt AC. "
3—2500 HP. 514 RPM. 13200 Volt AC. "

to be used in connection with roughing stands.

1— 400 HP. 200/600 RPM. 550 Volt DC. Motor
1—2500 HP. 150/300 RPM. 550 Volt D.C. "
4—3000 HP. 200/400 RPM. 550 Volt D.C. "

all to be used on finishing stands.

1— 500 HP. 400/800 RPM. 230 Volt DC. Motor
2— 600 HP. 400/800 RPM. 230 Volt DC. "

will be installed on edgers.

The power for the DC. units will be furnished from existing motor generator sets. The total horsepower represented for main drive on the above installation is 34,400. The annual rolling capacity of this mill will be 600,000 tons.

Youngstown Sheet and Tube Company of Youngstown, Ohio, are also building a new 4 High hot strip mill which will require the following electrical equipment:

1— 500 HP. 150/450 RPM. 600 Volt DC. Motor
6—3500 HP. 175/350 RPM. 600 Volt DC. "

Power for above to be furnished by two 6000 KW Motor Generator Sets.

In addition to the above DC. equipment, the following AC. motors will be installed:

1—3000 HP. 150 RPM. 6600 Volt Motor
2—3000 HP. 514 RPM. 6600 Volt Motor

This mill is also reported to have an annual capacity of 600,000 Tons.

A mill to produce 4,000 tons of hot rolled strip from slabs will be placed in operation at the plant of the McClouth Steel Company in Detroit during the latter part of September.

This mill is a single stand, reversing, two high, roller bearing equipped, with rolls, 21½" in diameter and 20" face. On each side of the mill is a furnace with coilers operating within the furnaces.

A 1500 Horsepower Direct Current Motor is used on the main rolls.

The Carnegie Steel Company have authorized the installation of a 4 High 42" hot strip mill at its McDonald plant near Youngstown and the Bethlehem Steel Company and National Steel Corporation are also considering the installations of similar hot strip mills.

Miscellaneous

A Diescher type seamless tube mill was installed during the year 1933 and another is under construction. The wall thickness and diameter of the tube are reduced simultaneously in this type of mill. By this method manufacturing of seamless tube is greatly simplified and the rate of production increased.

The Rotary Electric Steel Company has purchased an 18" billet mill driven by a 500 HP. wound rotor 443 RPM. 4600 volt motor, a 12" bar mill, driven by an 800 HP. 300/600 RPM. 250 volt DC. motor, and this year an order has been placed for a cold strip mill, driven by a 500 HP., 350-700 RPM. 250 volt DC. motor. Last year mention was made of the new process of making steel which is being rolled by the above company.

At the Chicago plant of the Revere Copper and Brass Company there was installed a 125 HP. variable speed direct current motor driving a main roll and the control of this unit was such as to cause the direct current to follow the speed changes of an induction motor driven roll just ahead of it in the tandem train. Naturally the direct current motor was a unit of inherent close speed regulation. The

LIST OF MOTORS INSTALLED JANUARY 1, 1934, TO JULY 1, 1934

No.		HP.	Speed	Voltage	Freq.	Type of Mill	Method of Drive	Customer	Plant Location	Mfgd. By
1	*	350	600	2,300	60	Copper Mill	Geared	C. G. Hussey & Co.	Pittsburgh, Pa.	W.
2		400	300/600	550	DC	Hot Strip Mill Fin.	Geared	Ford Motor Company	Detroit, Mich.	W.
3		500	150/350	600	DC	Hot Strip Mill	Geared	Youngstown S. & T. Co.	Youngstown, O.	W.
4		500	250/750	250	DC	Cold Strip Mill	Geared	Mesta Machine Co.	Homestead, Pa.	GE.
5		500	350/700	250	DC	Cold Strip Mill	Geared	Rotary Electric Steel Co.	Detroit, Mich.	GE.
6		500	400/800	230	DC	Hot Strip Mill Edg.	Geared	Ford Motor Company	Detroit, Mich.	AC.
7		600	400/800	230	DC	Hot Strip Mill Edg.	Geared	Ford Motor Company	Detroit, Mich.	AC.
8		600	400/800	230	DC	Hot Strip Mill Edg.	Geared	Ford Motor Company	Detroit, Mich.	AC.
9		600	514	2,200	60	Brass Mill	Geared	Western Cartridge Co.	East Alton, Ill.	GE.
10		700	514	2,200	60	Brass Mill	Geared	American Brass Co.	Waterbury, Conn.	GE.
11		800	600	440	60	Hot Strip Mill (Rough)	Geared	Ford Motor Company	Detroit, Mich.	AC.
12		800	600/800	600	DC	Cold Strip Mill	Geared	Wheeling Steel Corp.	Yorkville, Ohio	W.
13		800	600/800	600	DC	Cold Strip Mill	Geared	Wheeling Steel Corp.	Yorkville, Ohio	W.
14		800	600/800	600	DC	Cold Strip Mill	Geared	Wheeling Steel Corp.	Yorkville, Ohio	W.
15		800	600/800	600	DC	Cold Strip Mill	Geared	Wheeling Steel Corp.	Yorkville, Ohio	W.
16		800	600/800	600	DC	Cold Strip Mill	Geared	Wheeling Steel Corp.	Yorkville, Ohio	W.
17		1500	500	3,000	50	Sheet Mill	Geared	Asano Bussan Kaisha	Japan	GE.
18		2500	150/300	550	DC	Hot Strip Mill Fin.	Geared	Ford Motor Company	Detroit, Mich.	W.
19	*	2500	514	13,200	60	Hot Strip Mill Rough	Geared	Ford Motor Company	Detroit, Mich.	AC.
20	*	2500	514	13,200	60	Hot Strip Mill Rough	Geared	Ford Motor Company	Detroit, Mich.	AC.
21	*	2500	514	13,200	60	Hot Strip Mill Rough	Geared	Ford Motor Company	Detroit, Mich.	AC.
22		2500	600	13,200	60	Hot Strip Mill Rough	Geared	Ford Motor Company	Detroit, Mich.	AC.
23		3000	200/400	550	DC	Hot Strip Mill Fin.	Geared	Ford Motor Company	Detroit, Mich.	W.
24		3000	200/400	550	DC	Hot Strip Mill Fin.	Geared	Ford Motor Company	Detroit, Mich.	W.
25		3000	200/400	550	DC	Hot Strip Mill Fin.	Geared	Ford Motor Company	Detroit, Mich.	W.
26		3000	200/400	550	DC	Hot Strip Mill Fin.	Geared	Ford Motor Company	Detroit, Mich.	W.
27		3000	150	6600	60	76" Strip Mill	Geared	Youngstown S. & T. Co.	Youngstown, O.	GE.
28		3000	514	6600	60	76" Strip Mill Rough	Geared	Youngstown S. & T. Co.	Youngstown, O.	GE.
29		3000	514	6600	60	76" Strip Mill	Geared	Youngstown S. & T. Co.	Youngstown, O.	GE.
30		3500	175/350	600	DC	Hot Strip Mill	Geared	Youngstown S. & T. Co.	Youngstown, O.	W.
31		3500	175/350	600	DC	Hot Strip Mill	Geared	Youngstown S. & T. Co.	Youngstown, O.	W.
32		3500	175/350	600	DC	Hot Strip Mill	Geared	Youngstown S. & T. Co.	Youngstown, O.	W.
33		3500	175/350	600	DC	Hot Strip Mill	Geared	Youngstown S. & T. Co.	Youngstown, O.	W.
34		3500	175/350	600	DC	Hot Strip Mill	Geared	Youngstown S. & T. Co.	Youngstown, O.	W.
35		3500	175/350	600	DC	Hot Strip Mill	Geared	Youngstown S. & T. Co.	Youngstown, O.	W.
36	‡	4000	375	6600	25	Rod Mill	Geared	Bethlehem Steel Co.	Johnstown, Pa.	W.
37		7000	50/120	750	DC	Blooming Mill	Direct	Ford Motor Company	Detroit, Mich.	GE.

*—Synchronous Motors ‡—Wound Rotor Motor

installation was successful in that operation, has proven that the direct current motor speed change follows the induction motor speed change as the load on the induction motor varies.

MAIN ROLL DRIVE CHARTS

This year for the first time the charts covering motors installed on main roll drives have been arranged to include not only those sold during 1933 but also those contracted for during the first six months in 1934. The main roll drives sold for the first six months of 1934 are shown on Chart 1. Also in this report the only charts we are publishing are those showing the yearly and total number of drives, 300 H.P. and over, installed on all types of mills, the yearly and total motor H.P. installed on all types of mills and the yearly and total motor H.P. installed on strip mills where by far the most progress has been made. From Fig. 1 it is very apparent that business conditions are improving, for during the year 1933 there were 43 motors installed on main roll drives and orders have been placed for 36 drives during the first six months of this year. The number of drives sold does not give the complete picture for it is evident from Fig. 2 that the total horsepower installed in 1933 was 34,000 whereas in first six months of this year orders have been placed for 75,500 H.P. for main roll drives.

It is interesting to watch the trend from year to year in the application and design of these motors. During the year 1933 thirty-eight of the forty-three new main drives were DC. and the other five AC. This year twenty-four DC. motors and twelve AC. motors have been sold and the ratio of total horsepower of these two types is almost exactly the same as the ratio of DC. to AC. motors. No 25 cycle motors were purchased in 1933 and only one in 1934. In 1933 there was one rope drive, two direct drives and forty geared drives furnished and in 1934 all but one of the drives is a geared unit.

Synchronous motors are being used more extensively each year on main roll drives. In 1933 two were installed, one a 4700 HP. motor on a continuous rod mill and the other on a cold mill. In 1934 three 2500 HP. synchronous motors have been sold for hot strip mills and one 350 HP. on a copper mill. The three 2500 HP. motors which are to be used on the hot strip mills will be operated on 13,200 volts.

That it takes power to roll thin gauges is very evident from Fig. 3 which shows that to date over 450,000 HP. has been applied to strip mills. On no other type mill has there been so much power applied. On bar and billet mills three hundred and sixty thousand horsepower has been applied which is the nearest approach to the strip mills.

In 1933 a continuous rod mill driven by a 4500 HP. synchronous motor was installed, and in 1934 a 4000 HP. wound rotor motor was sold for a similar application.

This year a 7000 HP. motor has been purchased for a blooming mill drive. No new installations of this type have been made since 1931.

GENERATORS

Each year marks a new maximum in the turbine generator capacity. An 1800 RPM. steam turbine is now under construction rated 165,000 KW. Steam is received in the high-pressure cylinder at 375-pound pressure and a temperature of 825° F. In tandem with this is the double-flow low-pressure cylinder which in turn discharges into the condenser, held at 29-inch vacuum. Connected to the turbine is a single generator rated at 183,333 kva. at 90% power-factor, 13,800 volts, 60 cycles. The generator has two independent windings, each supplying an independent bus system.

The rotor is 32 feet between bearing centers. It is an assembly of steel plates and end forgings held together by massive bolts. One of them, having a clamping pressure of 9,000,000 pounds, is 13 inches

in diameter and is the length of the rotor; it is probably the largest high-strength bolt ever made. Though the rotor is made of several pieces it will behave in service like a solid forging.

Two hydroelectric generators, the world's largest both electrically and physically, will be delivered in 1935. With an output of 82,500 kv-a., they have an overall diameter of 40 feet, a height of 32 feet above the floor, and a weight of more than 2,000,000 pounds each. These two units are a part of the Boulder Dam project.

The Ford Motor Company is installing two turbines in their River Rouge plant at Fordson, Michigan.

One unit a 15,000 kilowatt non-condensing turbine will furnish process steam to the plant at 250 pounds pressure.

The second unit a 110,000 kilowatt vertical compound unit which will operate at 1200 pounds pressure is a duplicate to the large unit installed in the Ford plant during 1930.

The rating of this turbine is 110,000 kilowatts, 1800 R. P. M., 13,800 Volts 80 per cent power factor, three phase, sixty cycle with steam supplied at 1200 pounds gauge pressure, 900 degrees Fahrenheit total temperature and one inch vacuum.

TRANSFORMERS

Among the important developments in heavy duty transformers mention should be made of the two hundred thousand amperes welding transformer which was built this year and which will be used on the largest pipe welding machine in the world. The successful operation of these transformers is due to a number of valuable developments which were incorporated in the design and construction and which are briefly as follows: A positive circulation and equal distribution of forced air throughout the primary and secondary sections of the coil. Equal distribution of current and heating through the many primary and secondary multiple circuits. Reduction of stray losses and consequent elimination of local heating. Practical elimination of troublesome high resistance contacts in the heavy secondary circuits. Ease of installation and accessibility for inspection and cleaning. These improvements result in a higher power factor and consequently lower power bill.

OPEN HEARTH FURNACE CONTROL

A new development in the open hearth field during the year is automatic control of fuel supply from roof temperature. This equipment is particularly necessary in case of insulated roofs but is also decidedly worthwhile even without insulation. The high cost of renewing a roof may exceed the cost of the pyrometer equipment necessary to prevent the roof failure. It is important that true roof temperature be measured in applying the control since this may be higher or lower than furnace temperature at any particular time. The desired protection can be secured only by locating the temperature detecting element at the hottest part of the roof structure so that it will respond to temperature of the surface exposed to the flame action. Automatic control from this temperature measurement is applied to the fuel supply, which is reduced to a predetermined low value whenever temperature exceeds the set maximum and is returned to the desired operating rate when the temperature has dropped a suitable amount. This action is protective in nature; it occurs only when required to safeguard the roof structure and normally leaves control of firing rate in the hands of the operator.

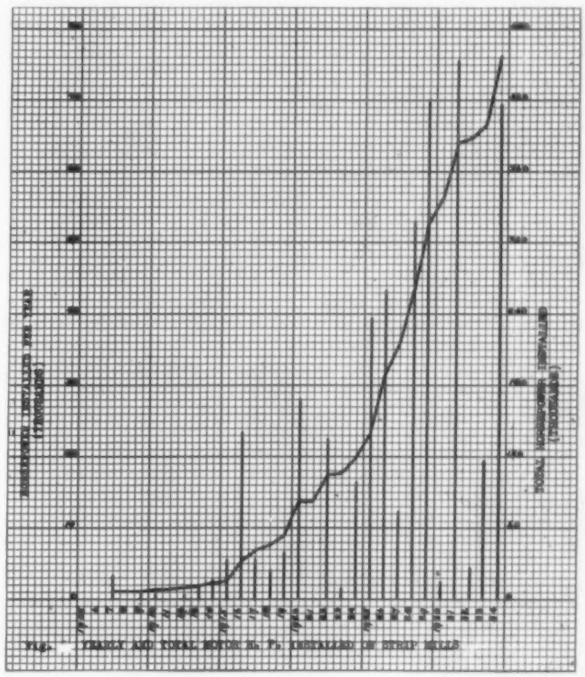

FIG. 3.

During the past year a number of applications of combined control for open hearth furnaces have been made including automatic reversal, furnace pressure control and proportion of air to fuel. The combined system is an extension of the equipment for automatic reversal from regenerator temperature difference. Proper coordination of all furnace operating factors has been found to have a marked influence on each phase of the operating problem, because of the interdependence of the various conditions to be controlled. Thus, the stable air preheat condition established by the automatic reversal from regenerator temperatures is conducive to maximum effectiveness of flame utilization and to maximum fuel economy. The automatic furnace pressure control favors the automatic reversing action by maintaining uniform pressure conditions under which the reversal can take place and also results in fuel savings due to limitation of cold air infiltration. The fuel air ratio control assists the automatic reversal to stabilize temperature conditions by equalizing the rates of fuel and air supply to both ends of the furnace, regardless of differences in burner and checker resistance to flow, and also functions directly to lessen fuel consumption. While no essentially new features are incorporated in any component part of the complete control here utilized actual experiences in applying the control have now made clearly apparent

the important effect played by each part of the system on the others. It is considered highly desirable that those considering open hearth control should direct their attention to the problem in its entirety.

CRANES

In the steel industry, there has been a tendency on the part of the users of steel to make ingots in big-end-up mould, the majority with hot tops.

These various types of moulds and ingots together with the conventional type little-end-up moulds require a stripping crane which will satisfactorily take care of these various types. A combination crane which includes all the features necessary to take care of these various types of ingots is now available.

No special type of stool is required in any of these various moulds. An improvement in connection with this combination stripper consists in mounting the extractor tongs on the same sides as the stripper tongs. With this design it is not necessary to lift the extractor tongs over the hot tops when moving the crane to the next ingot as both sides of the tongs straddle the hot top.

In addition to the external expanding type hydraulic brake, now in use, within the last year there has been designed an external type hydraulic brake for bridge motion. This brake is of the conventional shoe type. The master cylinder as well as the cylinder which actuates the brake shoes, are standard Lockheed parts. The brake cylinder is connected—one end directly to the shoe support, the other end to the actuating lever. The shoes are automatically adjusted to suit any variation in height of wheel due to wear in bearings or other causes. The advantages of the external type hydraulic brake are ease of operation, low cost of maintenance, adaptability for single or multiple units, with one source of operation and equal braking effect on all wheels. This feature especially useful in double bridge drive. It combines all the good characteristics of the high type soaking pit crane and at the same time can be installed in less space than the present low type machine.

Standard trolleys are now designed and built of the one piece steel casting and welded design, in which the hoist gears are of the spur teeth design, having the gear reductions enclosed in a single oil-tight case, the bottom half being built integral with the frame.

The cross travel motion is also of the spur gear type with the gear reductions enclosed in a single oil-tight case having part of the frame built integral with the main frame.

With this type of host the gear reducers are nested on one side of the trolley and in the case of two hoists they are nested, one on either side of the trolley, leaving the space in the center of the frame for mounting the sheaves above the trolley floor.

With this design of gearing however, it is necessary to use anti-friction bearings, due to the extremely short intermediate shafts.

The use of alloy steel and heat treated steels are being applied to a wide field of equipment to very good advantage.

Another crane manufacturer reports that when their first unit for stripping hot top ingots was developed the mold was held down with the stripping links, and for that reason it was necessary to use a special screw and nuts in order to be able to pull on the flat side of the buttress type thread. Now the mold is held down with the horseshoe-shaped casting, this casting taking the place of the usual bullnose which holds the nut down on the small-end-up ingot, and by using the horseshoe-shaped casting it is possible to retain the old screw and nuts, replacement of these parts not being necessary.

This same manufacturer has developed a scheme for stripping small-end-up ingots loose from the stools. This same long horseshoe-shaped casting holds the stool down while the tongs are used for loosening the ingot the same as though it were going to be lifted out of a mold.

It is now possible to strip standard or small-end-up ingots, big-end-up or hot top ingots, and also strip stickers from the stools, all with the same stripper. Simply use the bullnose or horseshoe-shaped castings, depending on which type of stripping is to be done.

Another crane builder has designed a new type steel mill crane. This crane was designed to weigh all loads lifted, instantly, accurately, and visibly. The scale proper is of the lever type. It is built-in as an integral part of the trolley. The entire load is weighed, eliminating the inaccuracies incurred when obtaining total weight by just weighing part of the load. Direct reading from the floor is obtained by means of the "Weightograph." The crane is all welded, girders, end truck, and trolley.

WELDING

Arc welding has progressed to a greater extent than probably any other industry during the past year. Improved welding technique, more efficient welding machines and better electrodes have each played a definite part in increasing welding speeds, producing better welds and cutting costs. Extensive research in the weldability of metals has led to increasing use of the electric arc in welding alloy steels.

This steady advance in arc welding has greatly broadened its field of application in both the shop and field. Among the most notable achievements of our time stands the completion early this year of the longest desert oil pipe line ever built. The Iraq pipe line, 1180 miles in length, taps the rich oil lands of Iraq — formerly called Mesopotamia — and crosses Palestine, Trans-Jordan, Iraq and Syria. Laid by the Mediterranean Pipe Line Company, a subsidiary of Iraq Pipe Line Company, this vast project employed 12,000 men and cost approximately $50,000,000. Laying the line and welding its sections together required 13 months and 200,000 welds.

Government commendation of shielded arc welding was evidenced during 1933 by extensive use of the process in construction of naval cruisers, lighters, submarines and destroyers. The U. S. S. Ranger, first vessel designed in this country to be operated exclusively as an aircraft carrier, employed arc welding extensively.

The past year also saw completion of the Dolomite, largest all-welded freighter ever built. Arc welding saved approximately 25% in the deadweight of this vessel.

Extensive rehabilitation of steel mills has been

accomplished by use of the electric arc. Electric welding has enabled the steel mills to use their own product—rolled steel—rather than purchase materials elsewhere. One company rebuilt a 16-inch mill using welding extensively and saving approximately 25% over the cost of older methods. Mill housings are now being welded. Bases and gear covers for drives of several of the new mills under construction are also being built by arc welding.

An interesting example of welded fabricated construction is furnished by the three drums built for the 150-ton cable-way at Boulder Dam. The two larger drums have an overall length of 16'6", and a diameter of 13' at the bottom of the rope grooves. The total weight of each is approximately 83,000 pounds. The rim on which the rope grooves are cut is fabricated from 2" thick plates. The third drum is approximately 12' overall length, by 8' diameter. So far as is known, these are the largest hoist drums which have ever been built of welded fabricated construction.

The use of thyratron control of resistance welding, both seam and spot, has been greatly extended during the year. These control equipments have found many applications in the manufacture of beer kegs, of ordinary steel, stainless steel, and aluminum. The results obtained by the application of thyratron control were much greater uniformity and higher speed. The thyratron control makes possible the welding of stainless steel without discoloration because the individual spots can be made in such a short time that only the steel at the weld itself is heated.

With the new "projection welding" and "shot welding" processes, the maximum value of current used and the duration of this current flow must be very carefully regulated to secure satisfactory operation. If the ampere seconds are too low, incomplete welds will result, whereas if the ampere seconds are too high, brittle welds and "burns" will be produced. Due to the very short time of application of the current in the "shot welding" process, a graphic meter does not measure the true peak value of the current applied. However, it does make a record, and once the proper conditions have been established by trial, the graphic instrument will measure whether or not these conditions are being maintained. As long as the record from the production machine has the same shape as the experimental record, satisfactory results will probably ensue. If the record changes its shape from that of the experimental curve, some important condition has been altered and unsatisfactory welds are apt to occur. With the application of "shot" welding to stainless steel and aluminum alloys, as now used in airplane work, in the new streamline trains, means of checking the uniformity of operation of welding machines is extremely important.

TRANSPORTATION

Each year brings us just that much nearer the time when most of the yard switching in our plants will be accomplished by means of Diesel locomotives in the smaller sizes and Diesel Electric in the larger capacities. The possibilities in Diesel engines are so great and need of increased efficiency in transportation is so urgent that, with all the engineering ability which is now engaged in this work, results are sure to be accomplished. The railroads of this country are aware of this fact as is evidenced by the high speed streamline developments which have been made during the past year.

OIL CIRCUIT BREAKERS

The 287,500-volt transmission lines from Boulder Dam to Los Angeles will be protected by eight superspeed impulse oil circuit breakers.

The breakers will be unusual in several respects: They will be used at a higher voltage than any previous breakers; they are rated to interrupt the circuit in slightly more than one-third the time of the fastest breakers heretofore available for high voltages; the complete units will weigh less than the oil alone now required for breakers of the conventional design; and they will require less than five per cent as much oil as would usual breakers for such voltage.

These new breakers will have an interrupting rating of 2,500,000 kilovolt-amperes, and will have a rated opening time of three cycles, or five one-hundredths of a second; the fastest heretofore available for high voltages have been rated eight cycles.

They will require approximately 1,000 gallons of oil each; if built with the conventional tank design, 23,000 gallons of oil would be required for 287,500-volt service.

The impulse principle has proved highly successful in electric railwaywork at 11,000 volts, and a series of thorough tests has proved it will be extremely efficient for high-voltage service. In impulse breakers a piston drives streams of oil into the arc paths when the contacts separate, giving a very rapid and positive interruption of the circuit.

The new breakers will be novel in appearance in that, instead of the usual large tank with two bushings projecting through the cover, each pole unit resembles the letter "E" turned on its side. The conductors will connect to the ends of the horizontal member, which contains eight sets of contacts in series. The oil piston is in the box at the top of the center vertical post. A motor-wound spring operating mechanism is in the housing at the foot of this post. The two outer posts contain current transformers and potential taps. The entire breaker is designed for most efficient use of the oil for interrupting the circuit and for reduction to a minimum of the time before the contacts separate.

An oil circuit breaker especially designed for severe starting duty in connection with a-c. main roll motors is now available. This breaker, which may be obtained in continuous ratings of either 600 or 1200 amperes at 15,000 volts, has demonstrated by tests that it will withstand more than 10,000 operations making and breaking 1000 amperes at 6600 volts, without change of oil or renewal of tips. It will withstand more than 50,000 operations with only minor maintenance, such as oil change and tip renewal. It has an interrupting capacity of 60,000 amperes for one second.

CONTROL

To a large degree the results which are being accomplished with modern machinery are made pos-

sible by the improvements in designs and materials in modern control. It is only possible to mention briefly a very few of these developments on this report.

The main application of an automatic sheet measuring device is in measuring the length of sheet or tin plate, as it passes through the mill and thus assisting the operator in setting his screw-down for the next pass, or, informing him whether or not the piece just rolled was of correct length. This advice is of particular advantage when used with mills having automatic roller and catcher tables. The length of the sheet is indicated on a large illuminated dial which has a fixed, as well as, a moving pointer. In normal operation the fixed pointer on the front of the dial is set in a position which indicates the length of the sheet desired. As long as that length of sheet is desired this fixed pointer does not require moving or resetting. The moving pointer on the illuminated dial begins to move as soon as the pack has traveled far enough to depress the flag switch on the catcher's table. This flag switch may be of any type now used including photo-electric cells. The moving pointer on the dial continues to move until the end of the sheet passes the flag switch when the moving pointer stops moving and stays in its position, thus giving the roller an indication of the length of the piece or pack.

A new type wide range timing relay has been developed for AC. and DC. This type of relay may be supplied with its own operating magnet or in some cases for attachment to a contactor so that an individual relay operating magnet is not required. This relay may be adjusted over a range from 2/5 of a second to 45 seconds. Timing accuracy is obtained over the entire range. The relay may be arranged so that after the operating magnet is energized, a predetermined time will elapse before the relay contacts move or after the magnet is de-energized, a predetermined time will elapse before contacts move. The device is available with normally open or normally closed time contacts or both.

WIRES, CABLES AND CONDUCTORS

Several years ago a paper was presented at the Annual Convention of our Association describing the use of aluminum structural channel shapes for heavy current busses. There have been quite a number of successful installations of this description since that time although few of them have been associated with the steel industry because of lack of activity in that field.

In connection with these channel conductors experiments with welded joints and off-sets have been carried on, but it was not until 1933 that any commercial installations, were made in this manner. Last year two industrial power installations using aluminum channel conductors and welding all of the joints were made. The advantages of this construction are obvious, i.e., simplicity, neat appearance, rigidity, and continuity of current carrying metal.

I believe that during the past year the makers of wires and cables have presented their case and that industry is beginning to realize that when these materials are to be purchased conditions which exist and problems involved should be made known to the makers of these products.

With most operating departments the matter of selection of proper cable for the job was given very little consideration and the purchasing departments have been responsible for the nature of the material furnished.

Before a new installation is made or an extension added get in touch with the cable manufacturers and you will be surprised when you learn what has been accomplished along this particular line.

TUBES

The radiation pyrometer equipment has been extended by a portable potentiometer indicator, which makes it possible to conveniently determine temperatures by the radiation method under working conditions and with the sustained accuracy and permanence of calibration characteristic of potentiometer equipment. The detector element can be sighted upon the work somewhat more easily than an optical pyrometer and responds to the temperature over an appreciable area rather than to a local "spot" temperature.

Indications and records can be obtained on temperatures above 1400 degrees in less than one second on photoelectric pyrometers. Additional applications of this type pyrometer have been made. Recently X-ray tubes have been built and installed which operate at 800,000 volts. These tubes are designed for twice the voltage of existing apparatus of a similar nature.

A new potentiometer pyrometer has also been developed this year. The mechanism consists of a galvanometer of short period arranged to make contacts of a duration proportional to the deflection of the galvanometer needle from neutral. These contacts which close the circuit to the electronic relay carry only a few micro-amperes of current, and are connected to the grids of pliotron tubes. A galvanometer contact permits the flow of direct current through one pliotron tube and the DC. winding of its transformer whose second winding is in series with one field coil of a reversible synchronous motor driving the potentiometer unit. This flow of direct current permits a flow of alternating current through the transformer and field coil, thereby rotating the motor in one direction. Rotation in the opposite direction is produced in the same manner by energizing the other field coil through a second electronic relay when the galvanometer needle swings to the other side of neutral. Automatic standardization takes place approximately every four hours at which time the dry cell is balanced against a standard cell.

The photox which converts light energy into electrical energy has made possible a method of indicating light intensity without an external source of power.

Ignitions rectify, convert and control accurately power supplied in certain welding operations. Still greater results are predicted with new developments of this nature.

METERS

A new instrument known as the boiler concentration recorder has been added to the meter line. This concentration recorder shows at all times the concentration of dissolved salts in the water in the boiler steam drum, the instrument operating on the electrolytic conductivity principle. The instrument may be used alone to guide boiler water treatment and blowdowns, although it is most useful in con-

junction with the condenser recorder. The concentration of dissolved salts in the boiler can be allowed to increase, the actual quantitative value being recorded at all times on the boiler concentration recorder, until mild priming takes place, as indicated by the condenser leakage recorder. Then, for the given type of boiler on which the instrument is installed, and the given type of water and treatment, this sets the upper limit of practical concentration, and from that time on it is only necessary to operate the boilers with salt concentration just below this limit.

Its use permits scientific regulation of blowdowns, preventing wastage of treated water and wastage of heat, and at the same time makes it possible to greatly reduce frequency and extent of boiler foaming or priming, thereby reducing erosion or coating of turbine blades, and burn-outs of superheater tubes.

An instrument which has been radically re-designed, is the piston type pressure measuring element. The actual pressure measurement is made through the means of a large and powerful helical spring as the weighing member, this spring being operated at so low a fibre stress that fatigue does not occur, and life is almost unlimited. This new piston type recorder has been designed so that cylinders and pistons can be interchanged easily, thus permitting selection of different ranges without requiring a complete new instrument. Several of these instruments are already in service by steel mills for hydraulic pipe testing, and some by the U. S. Navy in connection with oil gear propulsion mechanisms. One of these instruments is also in use for investigating water hammer in the water mains of a large city where several costly main ruptures have occurred.

BEARINGS

An unusual installation of anti-friction roll neck bearings was made at Jones and Laughlin Steel Plant this year. The bearing is 30″x48″x32″ and weighs four and one-quarter tons and is used on the 16½″ and 53″x42″ 4-high cold tin plate mill. This is reported to be the world's largest capacity roll neck bearing. A complete report on anti-friction bearings on roll necks is given elsewhere in this issue. Considerable attention has been given of late to the design of other types of roll neck bearings and very favorable progress has been reported.

MAGNETIC TESTING OF STEEL

For a number of years I have watched with interest research work covering the magnetic testing of metals. This year magnetic testing equipment has been installed in two plants for inspecting cold drawn bars for surface defects and internal seams and cracks. The detected imperfections are indicated by a curve produced by a beam of light shown on a ground glass. Bars up to 3 inches diameter can be inspected with the unit at the rate of 70 feet a minute.

MISCELLANEOUS

A complete line of explosion proof condulets is by far the most interesting development reported by one of the leading manufacturers of fittings. An explosion-proof conduit fitting that is flexible, has also just been announced. These fittings meet the demand for explosion-proof and water-tight conduit fittings having the mechanical features of standard flexible conduit in its ease of application. The fitting is adapted to the safe and economical wiring of gasoline pumps and explosion-proof motors and other uses where dust and vapors create a hazardous condition requiring the explosion-proof installation of electrical equipment. It is also suitable for water-tight installations on ships, docks and other exposed locations. Being flexible, the fitting eliminates the bending and fitting of rigid conduit in limited spaces, with consequent savings in time and labor, and provides a complete water-tight and vapor-tight conduit fitting installation. It withstands vibration, and is not only capable of withstanding 500-pound hydrostatic pressure, but each fitting is tested against leaks at 50-pound air pressure under water.

This same company announce a newly developed line of heavy duty plugs and receptacles for use with portable tools, appliances, and heating units. This new line is small in size, lightweight and fully enclosed, with cadmium plated heavy-gauge drawn steel housings used on plugs and connectors, permitting unusually rough handling without danger of accident or damage to the equipment.

A live line insulator tester which gives a direct reading as to the condition of the insulator under test has been perfected. This direct reading eliminates all possibility of error due to the human equation in testing insulators at line potential. A complete line of interlocks which has been developed are now on the market. They are used extensively in the interlocking of electrical equipment. They may also be applied to any mechanical or other process to automatically protect operators or all processes involved. Installations on oil circuit breakers, compartment doors, and switch operating handles provide a necessary safe guard on this equipment.

The most recent improvement in a lamp lowering hanger greatly broadens and improves its usefulness. The lower contact-elements can now be wired to the reflector instead of being built into the body of the hanger. Not only can they be easily and quickly removed and replaced without disturbing any wiring connection, but when in place they are fastened so securely that there is no chance of their getting out. This new improvement not only enables the installation work to be done much more easily and quickly, but all lamp repair work can be done in the electric shop, where all facilities will be at hand, instead of out on the job where no facilities are available.

CONCLUSION

Straws indicate which way the wind blows and in like manner the information given in this report may give an indication of the trend in the steel industry, but at the present time things are so uncertain that this may change over night. Should the national administration indicate by its actions that industry is to receive some encouragement, then we can look forward to a still greater improvement in conditions during the coming year.

Through the efforts and co-operation of the members of the Developments Committee and the organizations which they represent, this report has been made possible. The Association of Iron and Steel Electrical Engineers appreciates sincerely their continued support.

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E. J. Kulas, President, Otis Steel Company, extends a cordial welcome to the members of the A. I. & S. E. E. upon the occasion of their annual meeting to be held in Cleveland.

THE OTIS STEEL COMPANY

PLATES, SHEETS, STRIP STEEL
STEEL CASTINGS, PIG IRON

CLEVELAND, O.

August 1, 1934.

Association of Iron and Steel Electrical Engineers
1010 Empire Building
Pittsburgh, Pennsylvania

Gentlemen:

As a member of the iron and steel industry of Cleveland it affords me unusual pleasure and honor to extend to you a cordial welcome to Cleveland on the occasion of your thirtieth annual convention.

It is appropriate that your convention should be held in Cleveland. It was here in 1873 that the first company in the nation, if not in the world, was organized for the exclusive purpose of producing open hearth steel. In 1886 it was also Cleveland's distinction to have the first American company to produce steel ingots by the basic open hearth methods.

It was developments such as these that made the steel industry great. It is your tireless research and ingenious invention which continue to carry on the traditions of the industry and make it a constantly greater and more important factor in our nation's progress.

Cleveland is essentially an iron and steel city. Here iron ore, coal and limestone meet most economically, and here they are joined to make steel, the very foundation of our present day civilization.

But Cleveland's interest in iron and steel is far greater than the mere production of the basic material. In literally hundreds of plants the iron and steel is fabricated into thousands of useful articles which in turn find their way into every corner of the world.

It is our desire to make this convention memorable in every respect, and we look forward to the honor of being your hosts on this occasion.

Sincerely

E. J. [illegible]

President

TUESDAY, SEPTEMBER 18, 1934

9:00 A. M.—Registration, Mezzanine Floor, Hotel Statler. Chairman, C. A. Thayer, Chief Engineer, Republic Steel Corporation, Youngstown, Ohio.

9:15 A. M.—Business Session, Ball Room, Mezzanine Floor.

MECHANICAL, ELECTRICAL AND LUBRICATION DIVISIONS

Technical Sessions, Ball Room, Mezzanine Floor. Chairman, J. A. Clauss, Chief Engineer, Great Lakes Steel Corporation, Ecorse, Mich. Vice Chairman, A. D. Adams, Assistant General Superintendent, Spang Chalfant Company, Inc., Ambridge, Pa.

9:30 A. M.—"Developments in the Iron and Steel Industry," by W. H. Burr, Mechanical and Electrical Superintendent, Lukens Steel Company, Coatesville, Pa.

Chairman, C. C. Wales, Chief Engineer, Otis Steel Company, Cleveland, Ohio. Vice Chairman, J. S. Murray, Chief Electrical Engineer, Follansbee Brothers Company, Follansbee, W. Va.

10:00 A. M.—"A Review of Sheet, Tin and Strip Mills," by Stephen Badlam, Consulting Engineer, Pittsburgh, Pa.

Chairman, H. G. R. Bennett, Assistant General Superintendent, Carnegie Steel Company, Duquesne, Pa. Vice Chairman, F. W. Cramer, Electrical Engineer, Republic Steel Corporation, Youngstown, Ohio.

10:30 A. M.—"Electrical Equipment for High Speed Precision Merchant Mills," by R. H. Wright, General Engineering Department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

11:30 A. M.—Discusson.

ALL ENGINEERING DIVISIONS

Ball Room, Mezzanine Floor. Chairman, I. Lamont Hughes, President, Carnegie Steel Company, Pittsburgh, Pa. Vice Chairman, W. H. Burr, Mechanical and Electrical Superintendent, Lukens Steel Company, Coatesville, Pa.

1:15 P. M.—"Social and Industrial Relations Between the Employer and Employee," by Tom M. Girdler, Chairman of the Board and President, Republic Steel Corporation.

MECHANICAL, ELECTRICAL, COMBUSTION AND LUBRICATION DIVISIONS

Chairman, H. G. R. Bennett, Assistant General Superintendent, Carnegie Steel Company, Duquesne, Pa. Vice Chairman, F. W. Cramer, Electrical Engineer, Republic Steel Corporation, Youngstown, Ohio.

2:00 P. M.—"Precision Rolling Mills," by S. M. Weckstein, Assistant Chief Engineer, Timken Roller Bearing Company, Canton, Ohio.

Chairman, W. E. Miller, Electrical and Mechanical Superintendent, Bethlehem Steel Company, Johnstown, Pa. Vice Chairman, T. E. Hughes, Superintendent, Maintenance Department, Carnegie Steel Company, Duquesne, Pa.

3:00 P. M.—"Mechanical Billet Chipping," by G. W. Lentz, Consulting Engineer, Canton, Ohio.

OFFICIAL

CONVENTION AND IRON

AUS

ASSOCIATION OF IRON AND

SEPTEMBER 18,

TECHNICAL SESSIONS
HOTEL STATLER

3:45 P. M.—"Special Electrical Drives for Steel Cleaning and Processing Machines," by A. M. MacCutcheon, Engineering Vice President, and W. R. Hough, Electrical Engineer, Reliance Electric & Engineering Company, Cleveland, Ohio.

7:30 P. M.—Iron and Steel Exposition Visit by National Officers, National Engineering Committees, Membership and Guests—Cleveland Public Auditorium.

8:00 P. M.—Reception for Maintenance Engineers of the City of Cleveland at Iron and Steel Exposition, Cleveland Public Auditorium.

9:00 P. M.—Reception of the President W. H. Burr, National Officers and District Section Officers of the A. I. & S. E. E. at the Iron and Steel Exposition, Cleveland Public Auditorium.

10:00 P. M.—Exhibitors' Informal Dance, Ball Room, Mezzanine Floor, Statler Hotel. Members, Guests and Exhibitors invited.

Chairman, C. C. Wales, Chief Engineer, Otis Steel Company, Cleveland, Ohio. Vice Chairman, J. H. Barse, Engineering Department, American Steel & Wire Company, Cleveland, Ohio.

WEDNESDAY, SEPTEMBER 19, 1934

LUBRICATION ENGINEERING DIVISION

Technical Sessions, Ball Room, Mezzanine Floor. Chairman, C. C. Pecu, Lubrication Engineer, Bethlehem Steel Company, Lackawanna, N. Y. Vice Chairman, F. L. Gray, Lubrication Engineer, Illinois Steel Company, Gary, Ind.

9:30 A. M.—"Servicing of Steam, Turbine, Diesel and Transformer Oils," by R. P. Dunmire, Vice President, Buckeye Laboratories, Inc., Alliance, Ohio.

10:15 A. M.—"The Progress of Centralized Lubrication in the Steel Industry," by A. J. Jennings, Farval Corporation, Cleveland, Ohio.

11:00 A. M.—"Factors Affecting the Circulation of Oil," by Maurice Reswick, Lubrication Engineer, Standard Oil Company of New Jersey, New York, N. Y.

PROGRAM

AND STEEL EXPOSITION

PICES

STEEL ELECTRICAL ENGINEERS

19, 20, 1934

IRON AND STEEL EXPOSITION
CLEVELAND PUBLIC AUDITORIUM

11:30 A. M.—"New Developments in Lubrication," by G. W. Miller, President, American Lubricants, Inc., Buffalo, N. Y.

1:00 P. M.—Discussion.

ELECTRICAL AND MECHANICAL DIVISIONS

Technical Sessions, Lattice Room, Mezzanine Floor. Chairman, F. D. Egan, Electrical Superintendent, Bethlehem Steel Company, Lackawanna, N. Y. Vice Chairman, J. W. Bates, Electrical Engineer, Power Division, American Sheet & Tin Plate Company, Pittsburgh, Pa.

9:30 A. M.—"Electrical Characteristics of Main Drive Motors at Inland Steel Company," by R. W. Davis, Electrical Engineer, Allis Chalmers Manufacturing Company, Milwaukee, Wis.

10:30 A. M.—"Individual Motor Drives for Run Out Tables and Coilers—Dynamic Braking through Direct Current," by F. E. Harrell, Assistant Chief Engineer, and C. V. Gregory, Engineer, Reliance Electric & Engineering Company, Cleveland, Ohio.

INSPECTION TRIP—OTIS STEEL COMPANY, CLEVELAND, OHIO

2:30 P. M.—Special Buses, which the A. I. & S. E. E. will provide and guests must use, will leave the Statler Hotel. Members, Guests and Exhibitors invited. Tickets $1.50. (Reservations must be made for this trip.)

4:30 P. M.—Visit the Iron and Steel Exposition, Cleveland Public Auditorium. Buses will bring Inspection Trip Group to the Iron and Steel Exposition.

EXHIBITORS' RECEPTION AND DINNER

Chairman, J. A. Clauss, Chief Engineer, Great Lakes Steel Corporation, Ecorse, Mich. Vice Chairman, J. A. Morton, Assistant Chief Engineer, American Steel & Wire Company, Cleveland, Ohio.

6:00 P. M.—Exhibitors' Reception and Dinner, Exhibit Hall, Cleveland Public Auditorium. Make your reservations. Tickets $1.50. (Reservations must be made for dinner.)

Remarks by W. H. Burr, President, A. I. & S. E. E. and Mechanical and Electrical Superintendent, Lukens Steel Company, Coatesville, Pa.; J. A. Clauss, Chief Engineer, Great Lakes Steel Corporation, Ecorse, Mich.; W. E. Miller, Mechanical and Electrical Superintendent, Bethlehem Steel Company, Johnstown, Pa.

THURSDAY, SEPTEMBER 20, 1934

COMBUSTION ENGINEERING DIVISION

Technical Sessions, Lattice Room, Mezzanine Floor. Chairman, J. L. Miller, Assistant Chief Engineer, Carnegie Steel Company, Youngstown, Ohio. Vice Chairman, T. J. Ess, Combustion Engineer, Republic Steel Corporation, Massillon, Ohio.

9:00 A. M.—"Comparative Values of Fuels in a Steel Mill," by H. V. Flagg, Combustion Engineer, American Rolling Mill Company, Middletown, O.

Chairman, B. M. Stubblefield, Blast Furnace and Coke Oven Superintendent, Youngstown Sheet & Tube Company, Youngstown, Ohio. Vice Chairman, J. C. Barrett, Blast Furnace Superintendent, Carnegie Steel Company, Youngstown, Ohio.

10:00 A. M.—"The Development of the Modern Blast Furnace," by Arthur G. McKee, President, Arthur G. McKee and Company, Cleveland, O.

Chairman, H. V. Flagg, Combustion Engineer, American Rolling Mill Company, Middletown, Ohio. Vice Chairman, G. R. Carroll, Electrical Superintendent, Jones & Laughlin Steel Corporation, Aliquippa, Pa.

11:30 A. M.—"The Generation of Power in Industry by Diesel Engines using Heavy Fuel Oils," by J. H. G. McConechy, Chief Engineer, Sun Shipbuilding and Dry Dock Company, Chester, Pa., and K. E. DeRosay, Fuel Oil Engineer, Sun Oil Company, Philadelphia, Pa.

Chairman, F. E. Leahy, Fuel Engineer, Youngstown Sheet & Tube Company, Youngstown, Ohio. Vice Chairman, E. W. Trexler, Steam Engineer, Bethlehem Steel Company, Johnstown, Pa.

1:00 P. M.—"Super-Imposed Steam Turbine-Generator Plants for the Steel Mill," by A. G. Darling, Industrial Engineering Department, General Electric Company, Schenectady, N. Y.

Chairman, R. S. Bower, Open Hearth Superintendent, Corrigan-McKinney Steel Co., Cleveland, Ohio. Vice Chairman, G. M. Coughlin, Combustion Engineer, American Rolling Mill Company, Ashland, Ky.

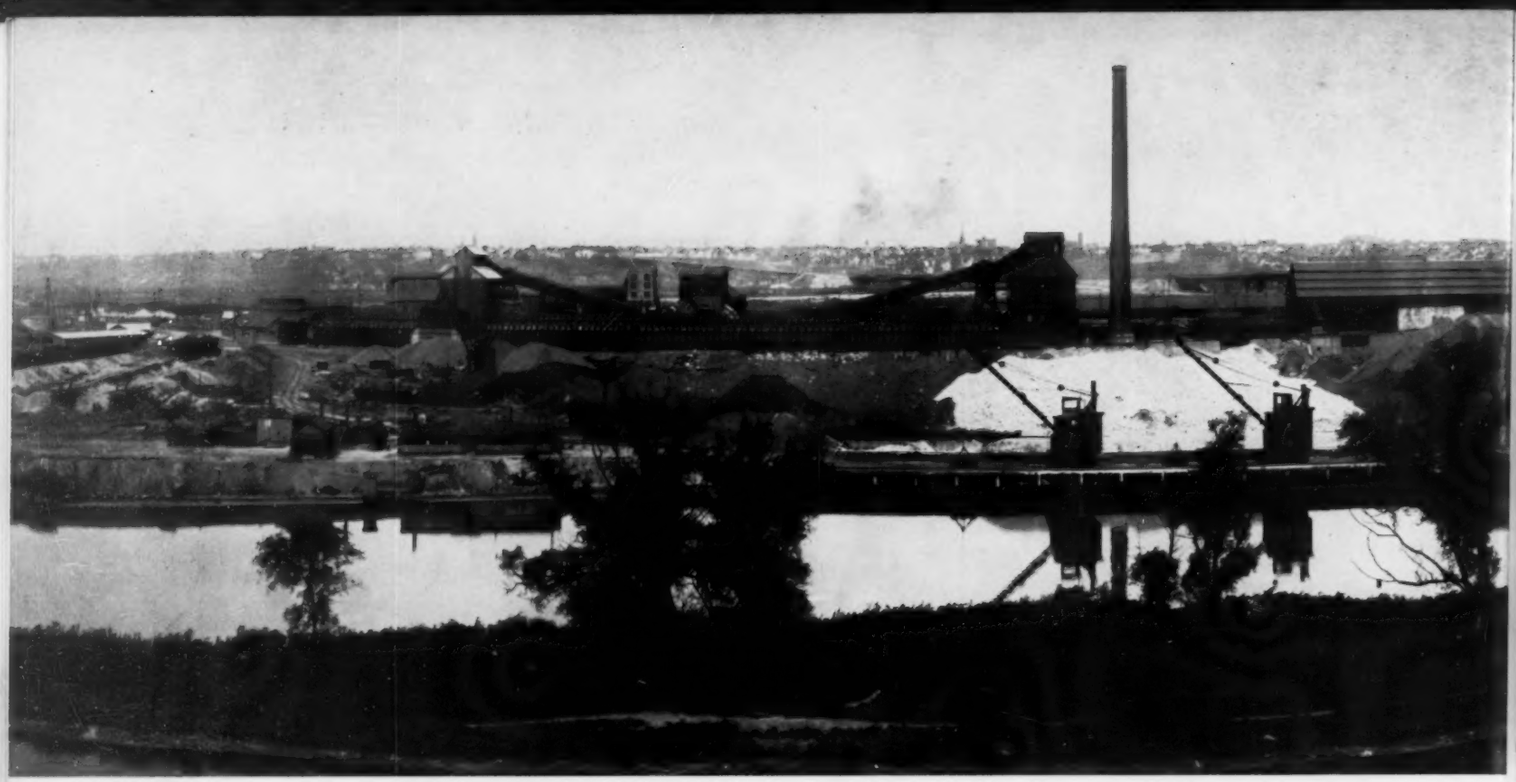
2:00 P. M.—"Use of Automatic Control on Metallurgical Furnaces," by A. J. Boynton, Vice President, H. A. Brassert & Company, Chicago, Ill.

Chairman, C. A. Kral, Assistant General Manager, Wheeling Steel Corporation, Steubenville, Ohio. Vice Chairman, W. N. Flanagan, Special Engineer, Carnegie Steel Company, Pittsburgh, Pa.

3:00 P. M.—"Theory and Practice of Immersion Heating with Gaseous Fuels with particular reference to its application in the Steel Finishing Industry," by E. B. Dunkak, Vice President, C. M. Kemp Manufacturing Company, Baltimore, Md.

Chairman, M. J. Conway, Fuel Engineer, Lukens Steel Company, Coatesville, Pa. Vice Chairman, H. B. Conover, Assistant Superintendent, Carnegie Steel Company, Mingo Junction, Ohio.

(Continued on Page 333)



PANORAMA VIEW

SPECIAL EXHIBITORS' DINNER

AFTER OTIS STEEL COMPANY INSPECTION TRIP

WEDNESDAY EVENING, 6:00 P. M.

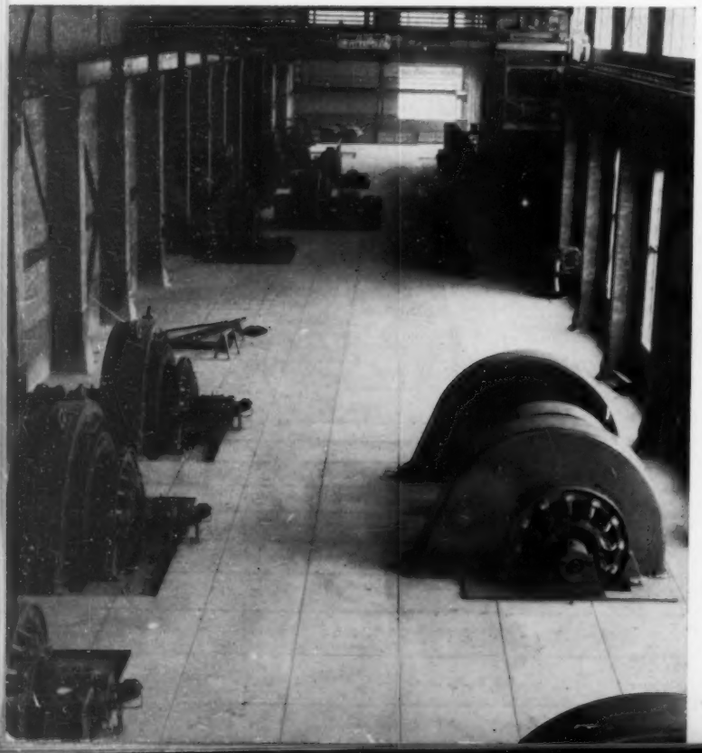
SEPTEMBER 19, 1934

CLEVELAND PUBLIC AUDITORIUM—
EXPOSITION HALL

Tickets $1.50

Inspection Trip must be made in special chartered buses leaving the Statler Hotel, 2:30 P. M. Reservation for trip must be made not later than Tuesday Evening, 5:30 P. M., September 18th.
Tickets $1.50 Round Trip

VIEW OF 72" HOT MILL MOTOR ROOM



ASSOCIATION OF IRON AND

CONVENTION IN

OTIS STEEL COMPANY

2:30

WEDNESDAY, SEP

Rarely is there to be found, in the annals of industrial development, a company with a historical background of greater interest than the Otis Steel Company.

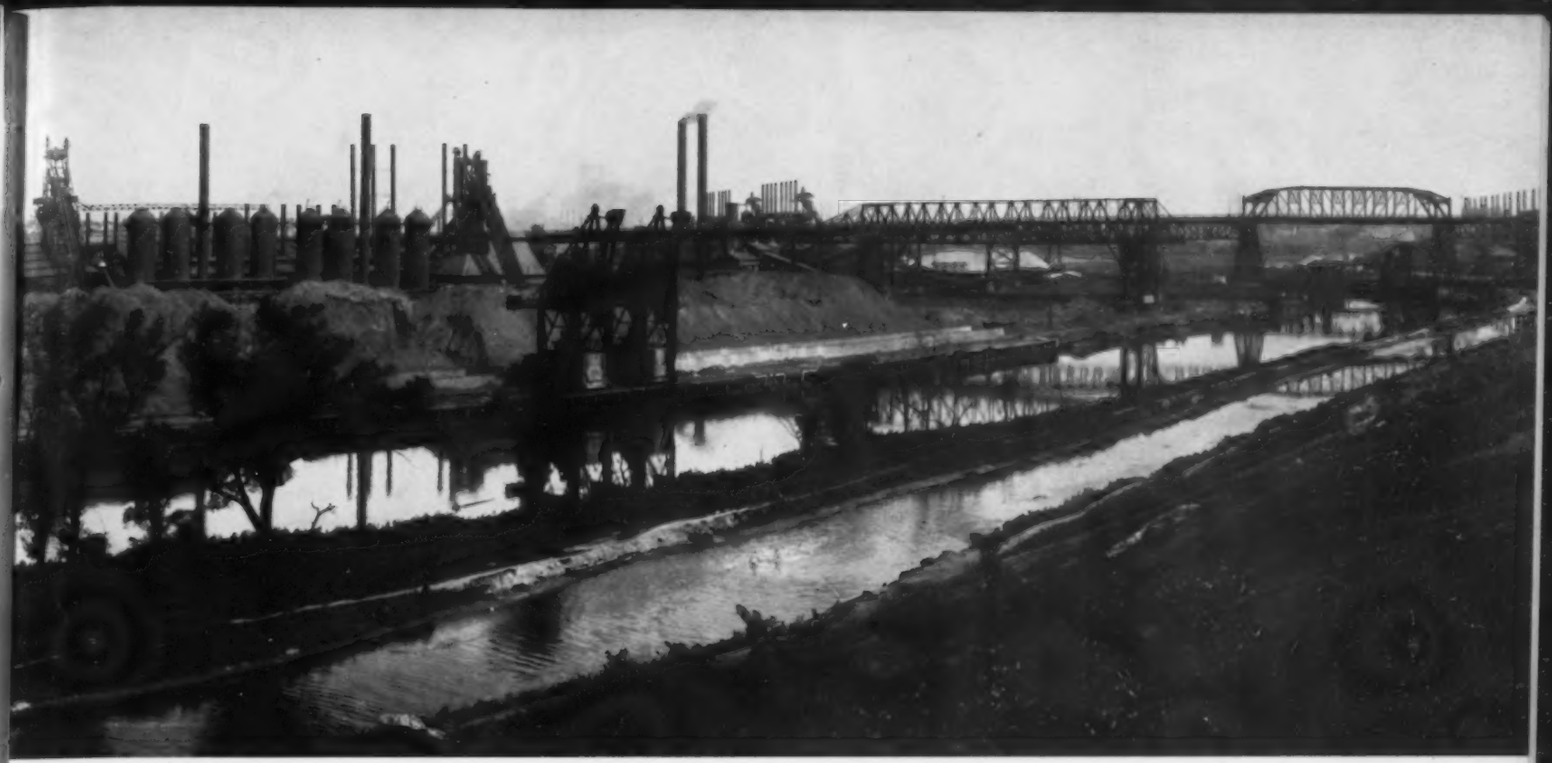
The founder, whose name the company bears today, had already prospered as a manufacturer of wrought iron axles and forgings when in 1873 the present company was organized to manufacture steel, under Sieman's license, by the acid open hearth process. This was the first plant in the United States to manufacture steel exclusively by the open hearth method.

Later, under the direction of S. T. Wellman, Otis pioneered in the manufacture of basic open hearth plates and castings.

From 1889 until 1919, the company, under English control, maintained unbroken its enviable record as a supplier of steel castings and plates to the railroads and other large users.

With the close of the World War, company control returned to Cleveland and the program of expansion, then already started, continued with the development of the Riverside Works.

The site of the original Otis Plant, now the Lakeside Works on the lakefront not far from downtown Cleveland, is occupied by the acid open hearth and by electric steel foundries where castings are made in a wide range of sizes up to 200,000 pounds. These foundries have an output capacity of 2,500 tons per month. The two plate mills at Lakeside, one 112 inch and one 152 inch, roll large plates from steel made in five 40 ton basic open hearth



OTIS STEEL COMPANY

STEEL ELECTRICAL ENGINEERS

SPECTION TRIP

CLEVELAND, OHIO

P. M.

TEMBER 19, 1934

furnaces. These mills have a capacity of about 14,000 tons per month.

The Riverside Works, located on the Cuyahoga River, has developed into a complete and modern steel manufacturing unit. This river is navigable for lake boats carrying ore and limestone to the companies docks at the Blast Furnace Plant. An ample portion of the 330 acres on which the Riverside Works is built is still available for future expansion.

With the assets of the Cleveland Furnace Company, Otis acquired its Coke Plant and Blast Furnace Division; including 100 Semet Solvay ovens built in three blocks and having a combined output of 30,000 tons of coke per month. The Blast Furnace Division consists of two units—Number 1 furnace having a hearth diameter of 18 feet 6 inches and Number 2 furnace having a hearth diameter of 17 feet 9 inches. These furnaces have a combined output of about 30,000 tons per month.

Since acquiring this plant, Otis has added a power generating unit consisting of two 10,000 k.w. turbo generating sets which are supplemented by two 5,000 k.w. units supplying the greater portion of the power requirements of the Riverside Works.

The original Otis development at Riverside consisted of a two stand, 84 inch, tandem plate mill and jobbing mill. In 1921-2 these were followed by the construction of a Sheet Mill, and still later, in 1924, by strip mills for the rolling of hot and cold rolled strip in widths up to 26 inches.

The Blast Furnace and Mill Division were then linked into a complete plant by the construction of the Steel Works Division, consisting of eight 150 ton open hearth furnaces and a modern 40 inch blooming mill and 24 inch bar mill.

With the subsequent development of continuous rolling methods, Otis, in 1931, added a 72 inch continuous strip mill for the production of strip in plate and sheet gauges up to 66 inches wide, and a 72 inch cold mill for the production of cold rolled strip in auto body sheet gauges, up to 66 inches wide.

The Otis Steel Company has maintained a strong and independent position in the steel industry. The ability and aggressiveness of present management is reflected by the last reported earnings of the company.

VIEW OF 72" HOT MILL

VISIT THE
IRON AND STEEL EXPOSITION

AUSPICES

MECHANICAL, COMBUSTION, LUBRICATION,
ELECTRICAL, SAFETY AND WELDING DIVISIONS

OF

Association of Iron and Steel Electrical Engineers

CLEVELAND PUBLIC AUDITORIUM **SEPTEMBER 18 - 19 - 20, 1934**

As in previous years, the Iron and Steel Exposition will be one of the features of the Annual Convention. The object of the Iron and Steel Exposition is to acquaint engineers with the status of the art in reference to the various lines of apparatus used in the Industry. Accomplishments by the use of improved devices, new applications, etc., will largely form the subjects of the papers and discussions at the technical sessions. Technical papers and discussions regarding the improvement of the quality ot product and economy of operation develop the urge to make improvements. Exhibits and Expositions develop this urge into a real desire as concrete suggestions and ideas are presented in these equipment displays.

In the Iron and Steel Exposition each year, the manufacturers who service the Iron and Steel Industry are presented an opportunity to display or exhibit the new developments in their products and equipment to the engineers and executives of the Iron and Steel and allied Industries. It is at the Exposition that the engineers and executives have the opportunity to inspect, examine and have demonstrated to them just what the equipment will do for them in their plants.

General View of 1931 Iron and Steel Exposition at Cleveland, Ohio

Cleveland Public Auditorium

FEATURES OF THE EXPOSITION

Here, at the Exposition, the leading manufacturers of America, servicing the steel mill industry, have on display the very latest developments in Combustion, Lubrication, Transportation, Mechanical, Electrical, Safety and Welding Equipment, etc. Many of the exhibits are in operation.

A novel feature of our Exposition this year is the "one-way-traffic" movement arranged for your benefit and convenience. By following the regular aisles of the Show you will pass each and every booth and so will not miss a single item of interest to you and your firm.

IRON AND STEEL EXPOSITION HOURS

Tuesday, September 18, 1934—1:30 P. M. to 5:30 P. M.
Evening, 7:00 P. M. to 10:00 P. M.

Wednesday, September 19, 1934—10:00 A. M. to 10:00 P. M.

Thursday, September 20, 1934—10:00 A. M. to 10:00 P. M.

LIST OF EXHIBITORS

Exhibitors	Booth Nos.
Ajax Flexible Coupling Co.	61
Ajax Wyatt Co.	1-15
Alliance Machine Co.	33
Allis-Chalmers Mfg. Co.	48
Aluminum Co. of America	120
American Air Filter Co., Inc.	26
Amsler-Morton Co.	47
Automatic Transportation Co.	108-118
Bailey Meter Co.	96
Baker-Raulang Co.	63
Bartlett-Hayward Co.	111
Benjamin Electric Mfg. Co.	50
H. A. Brassert & Co.	94
Brown Instrument Co.	18
Bull Dog Electric Products Co.	35
Bussmann Manufacturing Co.	78
Chase-Shawmut Co.	95
Chicago Rawhide Mfg. Co.	25
Clark Controller Co.	116, 117, 123, 124
Cleveland Crane & Engr. Co.	107
Cleveland Electric Illuminating Co.	1-15
Colt's Patent Fire Arms Mfg. Co.	62
Continental Roll & Steel Fdry. Co.	137
Crocker-Wheeler Electric Mfg. Co.	10
Crouse-Hinds Co.	90
Cutler-Hammer, Inc.	8-9
Dodd Company	1-15
Edison Storage Battery Co.	64
Electric Controller & Mfg. Co.	44-54
Electric Storage Battery Co.	20
Electrical Housekeeping, Inc.	1-15
Electrical League of Cleveland	1, 2, 12, 14, 15
Elwell Parker Electric Co.	6
Enterprise Electric Lighting Fixture Co.	1-15
Erie Steel Construction Co.	19
Farval Corporation	49
Fenn College	1-15
Fulton Foundry & Machine Co.	41
General Electric Co.	125-126-128-129
General Electric Supply Corp.	114
Great Western Fuse Co.	39
E. F. Hauserman Co.	1-15
Albert M. Higley Co.	1-15
Hodson Associates	134
Hodson Corporation	134
Holophane Co., Inc.	114
Homestead Valve Mfg. Co.	119

Exhibitors	Booth Nos.
Hyatt Roller Bearing Co.	115
Ideal Commutator Dresser Co.	23
Iron & Steel Engineer—A. I. & S. E. E.	43
I-T-E Circuit Breaker Company	109-110
Ivanhoe Division of Miller & Co.	114
Johns-Manville	77
C. M. Kemp Manufacturing Co.	53
Keystone Lubricating Co.	40
Leeds & Northrup Co.	46-52
Lubrication Products Co.	102
Lukens Steel Co. (Lukenweld Division)	106
Martien Electric Co.	1-15
Martindale Electric Co.	92
Minneapolis-Honeywell Regulator Co.	68
Morgan Engineering Co.	87-97
Morganite Brush Co., Inc.	24
National Carbon Co., Inc.	56
National-Erie Corporation	37
National Safety Council	127
North American Mfg. Co.	38
Norma-Hoffmann Bearings Corp.	36
Ohio Bell Telephone Co.	1-15
Ohio Carbon Co.	103
Ohio Desk Co.	1-15
Ohio Electric Mfg. Co.	34
Optical Lighting Institute	1-15
Pyle-National Co.	30
Reliance Electric & Engr. Co.	130-131-135-136
Rollway Bearing Co., Inc.	58
S-K-F Industries, Inc.	27-29
Smith-Obey	1-15
Standard Oil Co. (Ohio)	70
Steel-Penton Publishing Co.	76-79
Strong, Carlisle & Hammond Co.	1-15
Superior Carbon Products, Inc.	45
Thompson Electric Co.	91
Timken Roller Bearing Co.	31-32
Tool Steel Gear & Pinion Co.	88-89
Trabon Lubricating Equipment Co.	59-67
Trumbull Electric Mfg. Co.	3
United-American Bosch Corp.	65
United Engineering & Foundry Co.	86
Wagner Electric Corporation	22
Westinghouse Electric & Mfg. Co.	121-122-132-133
Westinghouse Electric Supply Co.	1-15
Weston Electrical Instrument Corp.	104
Yale & Towne Mfg. Co.	60-66

ON THIS AND THE FOLLOWING FIVE PAGES ARE PROMINENT STEEL MILL OFFICIALS WHO WILL OFFICIATE AT VARIOUS FUNCTIONS IN CONNECTION WITH THE 30th A. I. & S. E. E. CONVENTION AND IRON AND STEEL EXPOSITION

I. LAMONT HUGHES,
President, Carnegie Steel Company, Pittsburgh, Pa.

C. CLARKE WALES,
Chief Engineer, Otis Steel Company,
Cleveland, Ohio

E. W. TREXLER,
Steam Engineer, Bethlehem Steel Company,
Johnstown, Pa.

H. B. CONOVER,
Assistant General Supt., Carnegie Steel Company,
Mingo Junction, Ohio

B. M. STUBBLEFIELD,
Blast Furnace and Coke Oven Supt., Youngstown Sheet & Tube Company, Youngstown, Ohio

J. A. MORTON,
Asst. Chief Engineer, American Steel & Wire Company,
Cleveland, Ohio

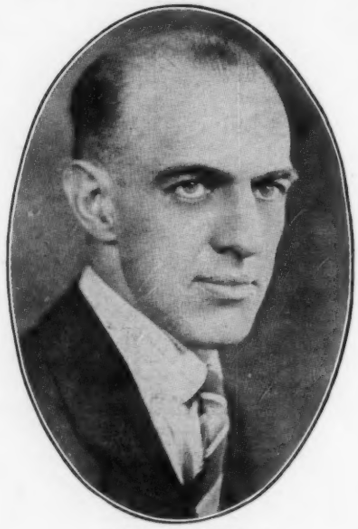
T. J. ESS,
Combustion Engineer, Republic Steel Corporation,
Massillon, Ohio

H. G. R. BENNETT,
Assistant General Supt., Carnegie Steel Company,
Duquesne, Pa.

J. A. CLAUSS
Chief Engineer, Great Lakes Steel Corporation,
Ecorse, Mich.

G. REES CARROLL,
Electrical Supt., Jones & Laughlin Steel Corp.,
Aliquippa, Pa.

A. D. ADAMS,
Asst. Gen. Supt., Spang Chalfant & Company,
Inc., Ambridge, Pa.



F. W. CRAMER,
Electrical Engineer, Republic Steel Corporation,
Youngstown, Ohio

J. L. MILLER,
Asst. Chief Engineer, Carnegie Steel Company,
Youngstown, Ohio

C. A. KRAL,
Asst. Mgr., Wheeling Steel Corporation,
Steubenville, Ohio

A. L. FOELL,
Chief Engineer, Arthur G. McKee & Company,
Cleveland, Ohio

T. E. HUGHES,
Supt. Maintenance Dept., Carnegie Steel Company, Duquesne, Pa.

F. E. LEAHY,
Fuel Engineer, Youngstown Sheet & Tube Company, Youngstown, Ohio

W. A. PERRY,
Supt. Electrical and Power Depts., Inland Steel Company, Indiana Harbor, Ind.

I. N. TULL,
Electrical Engineer, Corrigan-McKinney Steel Company, Cleveland, Ohio

C. C. PECU,
Lubrication Engineer, Bethlehem Steel Company, Lackawanna, N. Y.

W. E. MILLER,
Mechanical and Electrical Supt., Bethlehem Steel Company, Johnstown, Pa.

C. A. THAYER,
Chief Engineer, Republic Steel Corporation, Youngstown, Ohio

J. S. MURRAY,
Chief Electrical Engineer, Follansbee Brothers Company, Follansbee, W. Va.

W. N. FLANAGAN,
Special Engineer, Carnegie Steel Company, Pittsburgh, Pa.

J. H. BARSE,
Engineer, American Steel & Wire Company, Cleveland, Ohio

J. D. DONOVAN,
Mechanical and Electrical Supt., Republic Steel Corporation, Massillon, Ohio

W. S. HALL,
Supt. of Engineering and Construction, Illinois Steel Company, South Chicago, Ill.

F. D. EGAN,
Electrical Supt., Bethlehem Steel Company, Lackawanna, N. Y.

J. W. BATES,
Electrical Engineer, American Sheet & Tin Plate Company, Pittsburgh, Pa.

J. FARRINGTON,
Electrical Supt., Wheeling Steel Corporation, Steubenville, Ohio

OFFICIAL PROGRAM

(Continued from Page 323)

3:30 P. M.—"Propane and Butane as Industrial Fuels," by E. A. Jamison, Eastern Manager, Phillips Petroleum Company, Philadelphia, Pa., and W. H. Bateman, Propane Engineer, Sun Oil Company, Philadelphia, Pa.

WELDING ENGINEERING DIVISION

Technical Session, Ball Room, Mezzanine Floor. Chairman, J. D. Donovan, Electrical and Mechanical Superintendent, Republic Steel Corporation, Massillon, Ohio. Vice Chairman, W. A. Perry, Superintendent Electrical and Power Departments, Inland Steel Company, East Chicago, Ind.

9:30 A. M.—"Developments in Welding," by G. A. Hughes, Electrical Engineer, Truscon Steel Company, Youngstown, Ohio.

Chairman, G. A. Hughes, Electrical Engineer, Truscon Steel Company, Youngstown, Ohio. Vice Chairman, R. E. Lewis, Electrical Superintendent, Youngstown Sheet & Tube Company, Youngstown, Ohio.

10:00 A. M.—"Nitrogen in Metallic Arc Weld Metal," by Dr. J. W. Miller, Metallurgist, Reid-Avery Company, Dundalk, Md., with introduction by Dr. P. P. Alexander, General Electric Company, Schenectady, N. Y.

11:00 A. M.—"Oxy-Acetylene Welding and Cutting in Metal Working," by W. S. Walker, The Linde Air Products Company, Cleveland, O.

1:00 P. M.—"Recent Developments in the Welding of Aluminum Alloys," by D. I. Bohn, Electrical Engineer, Aluminum Company of America, Pittsburgh, Pa.

1:45 P. M.—"Electric Discharge Tubes for Resistance Welding," by Dr. J. Slepian and R. N. Stoddard, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

2:45 P. M.—"Load Factor and Power Cost—A Danger and a Possible Answer," by Paul M. Lincoln, Director, School of Electrical Engineering, Cornell University, Ithaca, N. Y.

3:45 P. M.—"Thermit Welding—Its Economic Importance in Steel Mill Maintenance," by J. B. Tinnon, Manager, Metal & Thermit Corporation, New York, N. Y.

10:00 P. M.—Formal Reception and Dance.

Chairman, W. H. Burr, Mechanical and Electrical Superintendent, Lukens Steel Company, Coatesville, Pa. Vice Chairman, J. D. Donovan, Mechanical and Electrical Superintendent, Republic Steel Corporation, Massillon, Ohio.

Association of Iron and Steel Electrical Engineers

Convention and Iron and Steel Exposition Committees

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T. J. Flaherty
F. O. Schnure
W. H. Baltzell
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W. T. Snyder
C. A. Kral
E. F. Blank
W. C. Suppler
F. E. Leahy

F. D. Egan
A. W. Duncan
H. D. Esterly
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B. D. Geeseman
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A. C. Cummins
J. D. Donovan
N. C. Bye
G. R. Carroll

F. A. Wiley
M. J. Conway
J. J Booth
C. C. Pecu
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H. E. Davis
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D. M. Petty
R. B. Gerhardt
W. Jackson
L. F. Quigg

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W. N. Flanagan
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A. L. Reichert

L. C. Edgar
I. N. Tull
R. C. Boak
D. Thomson
F. H. Kittredge
H. Cosden
C. A. Thayer
J. Farrington
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B. R. Shover
K. Landgrebe
G. A. Hughes
J. G. Gage

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G. R. CARROLL, Chairman

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L. W. Long
G. A. Kaufman
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C. L. Baker
W. Hilditch
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HEREWITH in the following pages is presented papers and abstracts of papers which are to be presented during the annual meeting.

TOM M. GIRDLER

Of particular interest to every man connected with steel shall be one of the feature addresses to be made at the annual A. I. & S. E. E. Convention, on Tuesday, September 18 at 1:15 P. M., by Tom M. Girdler, Chairman of the Board and President, Republic Steel Corporation.

For his subject Mr. Girdler has chosen "Social and Industrial Relations Between the Employer and the Employee." Eminently well qualified to discuss this subject by reason of his long service in the Industry and by the position of responsibility he now retains, Mr. Girdler will no doubt clarify some of the haze surrounding labor conditions in the industry.

Mr. Girdler's career, following his graduation from Lehigh University, has been one of Steel. Following his first position with the Buffalo Forge Company, he has been connected with the Oliver Iron and Steel Corporation, The Colorado Fuel and Iron Company, The Atlantic Steel Company and the Jones & Laughlin Steel Corporation of which company he was president from 1928 to 1930. Since this date Mr. Girdler has been managing the affairs of the third largest steel company in the world—The Republic Steel Corporation.

The Development Of The Modern Blast Furnace

By ARTHUR G. McKEE
President, Arthur G. McKee & Company,
Cleveland, Ohio.

Abtract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

ARTHUR G. McKEE

I have been requested to present a paper on blast furnaces before the interesting and gregarious Association of Iron and Steel Electrical Engineers. A brief outline of my paper is as follows:

(1) Brief history of the iron industry during the last half century-trend from merchant furnaces to furnaces forming part of an integrated steel plant.
(2) Trend in furnace capacities and recent tendency toward large hearth sizes.
(3) Development in blast furnaces within the last half century, culminating in modern furnace plants.

These with five sub-titles and eighteen sub-sub titles, such as furnace lines, linings and refractory development, ore storage, stove construction, etc., any one of which might hold your attention for the large part of one hour allotted to this talk. These three items are followed by three additional subjects, with some seven sub-titles. The last subject is "Recommendations for future progress," suggesting that I become for the time somewhat of a prophet.

As for the prophetic part of this talk, please allow me to suggest that I hope your association may give particular attention to the probability that the blast furnace of the near future will have a stock line diameter much nearer equal to the hearth diameter than is now the practice and that the size of the furnace bell will be increased somewhat in proportion.

I hope to give particular attention also to the subject of hot blast stoves and to suggest that the stoves of the near future will have checkers of smaller size and thinner walls and that for more than one reason these checkers will be of a uniform size and shape from the top of the stove to the bottom.

Comparative Values of Fuels In A Steel Mill

By H. V. FLAGG
Combustion Engineer, American Rolling Mill Company, Middletown, Ohio

Paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

Some years ago, the writer attempted to discuss this subject before this same group. At that time, emphasis was laid on the influence the flue gas losses from different fuels, at various temperatures and atmospheres, had on the performance of the fuels relative to the potential heat supplied. Since that time, the steel industry has seen considerable change in the status of common fuels brought about by such factors as increased prices of both coal and fuel oil, extension of the use of fuel oil to a point where in many communities the supply is inadequate to the demand, development of natural gas practice much better suited to the demands of steel mill operation, wider use of mixed gases, and application of raw producer gas to operations requiring close control. In view of the transitional character of the times, a discussion of fuel problems and the factors involved, seems to be in order.

For the purpose of this paper, the fuel applications in a steel mill are classified as follows:

1. Open hearth.
2. Soaking pits.
3. Reheating of heavy sections such as slabs, billets, and rounds.
4. Pack heating furnaces for sheet mills.
5. Continuous annealing furnaces.
6. Batch annealing furnaces.
7. Coating furnaces.
8. Miscellaneous.

Analysis of fuel applications enumerated indicates that the principles involved are identical in each case, differences being largely in degree. Requirements placed in order of importance are as follows:

1. Development of a heat transfer which will do the job required.
2. Control of furnace temperature which will result in uninterrupted operation and in uniformity of product.
3. Maintenance of a furnace atmosphere which will result in a high yield of product.
4. Choice of fuel which will answer these requirements at a minimum of cost.

Consideration of the classification of furnaces in light of the first requirement—development of a proper heat transfer—brings out wide differences in degree. The open hearth requires a flame of extremely high temperature which can be controlled exactly, both in shape and in placement, so that heat transfer to the bath may be maintained at a high rate and at the same time destruction of the furnace may be minimized. Soaking pit heating, as the name implies, is relatively a much slower heating operation but still is carried to a fairly high temperature, so that the heat transfer requirement is best met by a flame of moderate temperature and large gas volume, with high heat transfer characteristics and at the same time without undue tendency to cut or wash. The reheating furnace classifications include a wide variety of furnaces operating over a considerable temperature range but all have in common a similarity in heat transfer requirement in that an even distribution of heat over the entire furnace is important. In the continuous furnaces, the heat transfer must be so organized that the final stages of heating are accomplished at a low temperature difference between furnace, flame, and stock. Reheating furnaces usually work under a limitation in that they are subject to the operation of the mills which they serve and so have frequently to take care of mill delays, order changes, etc. If the furnace is to absorb such interruptions without losses in production or quality, control of the heat transfer rate must be quite flexible. Heating of continuous annealing furnaces is usually a relatively simple matter since temperatures are moderate and loads are regular. Where the furnace is long with respect to length, distribution of heat is simple, but when, as in the case of pipe annealers or wide sheet normalizers, the furnace has great width as compared to length, the problem of applying heat uniformly in all sections of the furnace becomes quite difficult. The type of flame which seems to best meet the requirements of reheating and annealing furnaces has considerable luminosity, relatively low flame temperature, contains a considerable amount of unburned combustible, and has large gas volume. Such a flame has a high heat transfer rate, lends itself well to even distribution of heat, and stands delays or interruptions of operation with minimum of damage to production or quality of product.

In batch furnaces for either reheating or annealing, where the stock is charged cold, the use of a low flame temperature, large gas volume fuel results in a slow, loggy heating-up period. After the charge has attained some temperature, the heat transfer characteristics of such a fuel have considerable advantage. For such an application, a rich fuel with high flame temperature and rapid flame propogation characteristics, which can be manipulated to produce a luminous flame, has obvious advantages.

In all the foregoing discussion, the heat transfer is predominantly radiation to the charge or stock from the flame. In the coating furnaces where a bath of metal is heated through the container, the heat transfer is quite different. In conventional settings, the transfer is generally radiation from the wall with some convection to the pot. The large amount of heat storage in the walls together with the slow transfer through the pot and equalization in the bath conspire to make the entire system very sluggish in response to fuel changes. While bath temperatures are moderate, it may nevertheless be necessary to operate the furnace at nearly destructive temperatures if the required heat input is to be maintained. Such combinations of circumstances makes very attractive the use of a recirculating system to increase materially the velocity of the gases passing around the pot, which results in lowering the

temperature of the gases and increasing the convective heat transfer. Another advantage of this system is that it lends itself to the use of cheap fuels better than does the conventional setting.

The miscellaneous uses for fuel about a steel mill such as drying runners and ladles in the open hearth, shaping rolls in hot mills and cold rolls, drying furnaces for flashing off the moisture film after pickling, hot water heating, call for local heat application for which a clean, rich gas is ideal. While such fuel uses ordinarily receive scant consideration in the general fuel picture, their aggregate may mount up to a surprising figure and close study reveal surprising opportunities for saving.

The requirement for a successful fuel application given second place in importance is that of control of furnace temperature which is necessary for continuous, uniform operation. Once having established furnace conditions which combine for satisfactory performance, any departure from those conditions has an adverse effect. The change may be so slight as to escape notice at the moment, but eventually the accumulated effect attains such magnitude as to have a serious influence on either output or quality and usually both. This factor is of great importance in all of the furnaces found in a steel mill. In an open hearth furnace, a momentary lapse in heat application at a critical period may affect both the time of heat, the yield, and the quality of the steel out of all proportion to the magnitude of the lapse. In reheating furnaces, changes in temperature may go unnoticed and the heating of the stock become progressively worse until mill operation must be interrupted while furnace conditions are being corrected. Most heaters in their efforts to avoid such a contingency, tend to carry their furnaces at temperatures in excess of what is actually required which has adverse effect on yield and fuel consumption.

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Factors which affect controllability of temperature can be stated as follows:

1. Stability of fuel, which involves both uniformity of composition and regularity of supply.
2. Controlled air supply. Close regulation of fuel supply avails nothing if the air supply is not controlled in ratio. This factor accounts for the almost universal use of fans on modern furnaces.
3. Controllability of fuel and air in ratio. Solution of this problem is simple with clean, lean fuel, such as mixed coke oven and blast furnace gas; becomes more difficult with clean rich gas, such as natural gas; is still harder with producer gas; and is exceedingly difficult with a rich fuel like heavy fuel oil. The volume of fuel to be handled in relation to the volume of air, in the latter case, is very small and it is difficult to find either a combination of valves with flow curves nearly enough alike to hold the ratio constant, or a system of measurement to which ratio control can be applied. The open hearth furnace is a notable exception to this rule for the reason that the amount of fuel used is so much greater than on other steel mill furnaces that measurement of flow is not difficult.

That the importance of temperature control is realized is evidenced by the widespread use of equipment designed to either keep the various factors under control automatically, or to provide information which makes manual control simple. Automatic control, pyrometers, flow meters, manometers, and pressure gauges all aid in maintaining close furnace regulation. The greatest handicap to wider use of automatic control has been the inadequacy of the equipment offered. So far, the writer has failed to find control equipment which will make a large change in fuel supply when required and still retain the fine touch necessary to take care of the small changes incidental to normal operation, without over-running. Apparatus which must be reset to handle changes in load falls so far short of its purpose that its value, except in the hands of exceptionally intelligent operators, is questionable. Another cause of dissatisfaction with automatic control equipment has been the failure to realize that even though furnace temperatures may be held in close range, changes in fuel supply will affect the circulation of gases within the furnace to such an extent that total heat transfer rate may be materially affected.

Control of temperature and control of atmosphere are closely related in that each are influenced by the same factors. Total heat transfer rate is affected by variations in atmosphere as well as by variations in temperature and of circulation of gases, especially if the luminous flame is employed. While it is important that the atmosphere best suited for

heat transfer be established and maintained, atmosphere is also important because of its influence on the quality of work done. It is universally accepted that oxidation of steel is inevitable in a conventional atmosphere made up of carbon dioxide, carbon monoxide, hydrogen, and water vapor, at flame temperature. The character and the amount of the scale formed by such oxidation can be controlled within limits by the composition of the atmosphere used, so the skillful heater manipulates his furnace atmosphere to produce a scale best suited for the particular operation with which he is employed. It follows that the various factors affecting atmosphere must be under close control.

The question of which fuel will best meet the conditions discussed above for any particular application may sometimes present a very involved problem. Considerations such as those enumerated below must be carefully analyzed and evaluated:

1. What fuels are available?
2. Is the fuel supply adequate and stable?
3. Is the cost reasonably stable or does it fluctuate widely?
4. How much expense is required for preparation, as for instance gasification for producer gas, or pumping, heating, and atomization for fuel oil?
5. How much capital expenditure is required for prepartion and distributing facilities?
6. Are the cost of furnaces involved comparable for all the fuels to be considered?
7. Is the cost of furnace maintenance comparable?
8. How well suited are the available fuels for development of the required heat transfer?
9. How do they compare as regards adaptability to control, either manual or automatic?
10. Will furnaces produce equaly well on all fuels, or must there be credits to one and debits to another?
11. Will the yield of good product be comparable?
12. How will fuel consumption per unit of product compare?
13. When all the various items of gain or loss are evaluated and added together, how do the overall costs compare?

The fuels commonly used in a steel mill include natural gas, coke oven gas, blast furnace gas, mixed gas, producer gas, and fuel oil.

From the standpoint of utility, natural gas probably comes closely to being the ideal fuel. Where available, the supply is usually fairly stable, especially since the advent of a network of pipe lines connecting widely separated gas fields. Distribution about a plant is simple and expense for preparation or handling is nil. Furnace construction for the use of natural gas is simple and relatively inexpensive and furnace repair costs are usually less than for any other fuel. For most steel mill applications, development of the required heat transfer is a simple problem, although the luminous flame condition which seems to be best suited for reheating furnace operation, is not so easy to obtain with natural gas and requires special treatment. The atmospheres found in clear flame natural gas reheating furnaces are not conducive to either good yield or good quality of product, since the scales formed are on the excessive side and are so hard and dense as to make their removal difficult. Where the luminous flame has been developed, these objections seem to have largely disappeared. Natural gas contracts are generally written to cover long periods of time so the price of this fuel can be considered stable. Unfortunately, the high cost of natural gas—development producing fields, lease rentals, pumping cost, cost of long pipe lines, wide-spread organization required, leakage, seasonal loads, and necessity for large reserves to take care of peak loads—makes it difficult for this fuel to compete with moderate price coal or oil as a universal steel mill fuel.

Those steel plants having coke plants, have at their command a quite satisfactory fuel for general purposes, although it is often a mixed blessing. If the supply is sufficient to take care of loads over peak demands, the problem of profitably using all the gas during periods of low demand is apt to be trying. If the converse is true and the supply is inadequate for full loads, some customers are bound to suffer, either from shortage of fuel or from forced substitution of some other fuel. The relatively low carbon content of coke oven gas makes it extremely difficult to establish luminous flame conditions, which is a marked disadvantage. Application of automatic control with coke oven gas is not difficult provided the gas has been adequately cleaned and the supply is stable.

Blast furnace gas has not had widespread application as a steel mill fuel but there has been a growing realization of its value for some years. Unfortunately, the rather high cost of necessary cleaning equipment and distribution facilities coupled with the state of poverty in which steel mills have been living in recent years, conspire to make extension of its use rather slow. Blast furnace gas has admirable characteristics for many purposes—high carbon content, low water plus hydrogen content, low flame temperature, and large volume. Its most extensive use, outside of stove and boiler fuel, is for mixture with coke oven gas to make a fuel of about 250 BTU per cubic foot for general steel mill use. Mixed gas from all standpoints approaches most nearly the ideal as a general, all-purpose fuel. Variation in loads is easily taken care of by adjusting the proportion of blast furnace gas automatically to maintain constant pressure in the system. The writer has for years realized that heating value can be manipulated within fairly substantial ranges without serious effect on operation, whereas slight variations in pressure may cause serious trouble, especially on the consumers at the tail end of the system. Fortunate indeed are those plants which have coke plants and blast furnaces in balance with their steel plants, and have had the vision and the means to install cleaning, mixing, and distribution facilities, so that practically the entire fuel supply comes into the coke plant as coal.

Fuel oil has found steadily increasing application in steel mills in recent years due to its wide flung supply, its cheapness, and its adaptability to many operations, particularly the open hearth. Unfortunately for the steel industry there is after all a close limit to the amount of fuel oil available and the time has come when a period of full operation in the steel industry brings demand and supply so close together that the situation is distinctly uncomfortable for

plants depending on this fuel for their main source. Refineries are constantly striving for higher gasoline yields from their crude and each advance in practice reduces accordingly the production of fuel oil, so that the situation cannot be expected to improve, but probably will become worse. The characteristics of present day heavy fuel oils make it the ideal open hearth fuel. In the quantities used in an open hearth furnace, oil is easily controllable, lends itself to the development of extremely high heat transfer, makes for high furnace production and high yield, furnace construction is simple and relatively inexpensive, furnace life is long, and repair cost is low. In comparing oil and producer gas for open hearth, these factors must all be analyzed closely and their effect on over-all cost evaluated. For reheating operations, oil has some distinct disadvantages. While development of luminous flame heat transfer is simple and furnace output is high, the high flame temperature of fuel oil has a harsh effect on surface and produces excessive scale with characteristics which make necessary extremely careful handling. Another disadvantage oil has, is that it is difficult to apply in small amounts where close control of temperature and atmosphere are required, for instance, in a multi-burnered pack heating or normalizing furnace. Where combustion chambers separate from the heating chamber proper, are provided, acceptable operation may be secured but even here the close control of temperature and atmosphere easily obtainable with other fuels, is difficult to establish. In spite of the disadvantages stated, there are many reheating furnaces operating satisfactorily on fuel oil at reasonable cost.

Through the changing conditions of the last few years, producer gas had made little gain as an all purpose fuel and has even lost considerable ground in the open hearth since the advent of heavy fuel oils at relatively low cost. This fuel has many advantages for a majority of applications and at the same time has perhaps just as many disadvantages. The price of coal is usually stable, especially where steel companies own their own coal properties. The supply is dependable and the spread between supply and demand is safe. Producer gas has a high carbon content with relation to hydrogen so that it naturally burns with a luminous flame which has very good heat transfer characteristics. Producer operation can be organized to deliver a constant supply of uniform quality gas which can be easily applied with automatic control to give acceptable temperature and atmosphere control. The writer has in mind producer operation as far different from the practice of ten years ago, as is the natural gas practice of today from that prior to the development of the proportioning burner. In the first place, the modern producer **should** have an output far in excess of that ordinarily considered as good practice. Few people realize that when they think of 50 lbs. of coal per square foot as good practice, that they are probably getting gasifications all the way from 25 lbs. to 75 lbs. across the diameter of the producer, and that they would get better quality gas if they were organized to gasify 75 lbs. for each square foot of area. Equipment has been developed to control automatically the quantity and quality of gas produced so that the fluctuations of each, which have been usually considered as inevitable, can be largely eliminated. The writer had occasion recently to observe an open hearth furnace fired with producer gas where the only attention the producer got, was given it by the furnace melter. This furnace operated on close requirements for both quality and time of heat. The quality of producer gas usually considered as fair also leaves much room for improvement. The writer had occasion to observe recently a producer gas practice where the carbon dioxide content was below 2.5% and the carbon monoxide above 29%. To those familiar with ordinary practice, these figures should open up interesting possibilities. The scaling effects of a properly organized producer gas flame will compare favorably with any other carbonaceous fuel, for the scale is moderate in amount and of a character which handles well and still cleans easily. The cost of a producer gas plant and distribution system is admittedly high and furnace construction for this fuel is usually higher than for other fuels, but when these added costs are charged to fuel cost over the life of the plant, the burden is light in view of the benefits to be gained. Considering that natural gas must always carry a heavy burden of cost, and the fuel oil situation promises to become more acute as time goes on, the future of producer gas as an all-purpose fuel appears much brighter at the moment than it has for the past several years.

Any attempt to set up comparative values of fuels in terms of money is bound to be futile since so many factors enter into the over-all fuel cost. Local conditions in each plant impose different requirements on fuel utilization which make it impossible to set up standards which all can meet. The author has attempted to state some of the factors involved and to discuss them in a limited manner. Many of the ideas expressed will lead to controversy, undoubtedly, and it is hoped that the discussion has been general enough in nature that all interested persons will feel free to give their opinions.

Use of Automatic Control on Metallurgical Furnaces

By A. J. BOYNTON
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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

The desirability of maintaining a prescribed condition with respect to fuel flow, size and shape of flame, exit gas flow and composition of furnace atmosphere has never been questioned although the full measure of benefits of such stabilization are not completely understood, because of lack of experience.

This lack of experience arises from two causes, the first of which has been a faulty design and construction of the furnace itself and the second an inability on the part of makers of regulating equipment to provide control facilities which met the academic requirements of fuel flow and combustion and which were at the same time reliable and thoroughly practical. Within the past few years both of these objections have been removed. Furnace proportions and methods of construction have been improved so as to give a much better contact between heating gases and the work. New burners changed both in design and location assist in determining the size, shape and direction of flame. Insulation has prevented heat losses while at the same time making the furnaces substantially air tight against the existing differences in pressure.

In the meantime systems of control equipment have been developed which meet the demands for regulation of metallurgical furnaces. These demands are more exacting than are those of other applications of control. Inaccuracies which are of little consequence in boiler regulation are intolerable in a present day melting or heating furnace. Furthermore, in boiler regulation the operator has comparatively little to engage him except the processes of combustion and the resultant formation of steam and a regulating system which requires frequent attention may be successfully used. In metallurgical furnaces the attention of the melter's helper or heater is primarily engaged by the process of steel making or rolling and a minimum of attention to the processes of combustion is essential. Furnace control should therefore be fully automatic and should require attention only as the conditions in the furnace require to be changed.

Control of furnaces divides itself into several phases. Most important in the opinion of most engineers is the regulation of furnace pressure, whereby the removal of gases from the furnace is exactly synchronized with their formation, infiltration of air is prevented and a constant shape and size is given to the flame. Of practically equal importance is the control of heat input. This is comparatively simple

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where a single fuel is used, less simple where two or more fuels are employed. Means are now available whereby a given heat input may be maintained, regardless of the number of fuels. The process is one of summarizing and regulation may be applied to any fuel in such a manner that compensation is effected for variation in one or more of the other fuels. A truly automatic regulation of fuel should be based on the temperature of the furnace or the work within the furnace rather than on an arbitrary inflow of heat. Means are now completely developed whereby regulation of the temperature of the open hearth roof may be controlled. The heating of steel to a desired temperature has not been so satisfactory, since the temperature which forms the basis of automatic regulation may not be that of the interior of the steel. Various approximations are therefore necessary in regulation by temperature of fuel to steel heating furnaces.

Various means exist for regulating the length and shape of the flame. Some of these are based on burner design, some on automatic regulating devices.

Regulation of atmospheric composition within the furnace may be effected by means of a metered content of oxygen, CO_2 or fuel gas or more simply by ratio regulation between fuel and air supply. Means exist whereby the air regulation compensates for temperature and pressure of air and gas and furnace leakage and gives a true proportioning with these factors correctly evaluated. The effect on furnace economy and repairs and on scale formation is quite remarkable.

Regulation of furnaces produces a fuel economy of 10% or more. It is probable that for every cent saved in fuel, another is saved in repairs. The cost of regulation is very small compared either to the value of furnace or output. Automatic regulating equipment if practically designed is capable of making the greatest possible saving per dollar invested of any presently possible furnace improvement.

Precision Rolling Mills

By S. M. WECKSTEIN,
Asst. Chief Engineer, Timken Roller Bearing Company, Canton, Ohio.

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

Recent developments in general industry and especially in the automotive industry have brought forth a demand for similar or even greater precision of the products generally rolled on merchant mills. Unfortunately this type of mill had not kept pace

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with general rolling mill development toward greater precision. The result was that a number companies, who have been able to produce a product held closer than standard commercial tolerances, have enjoyed a greater volume of business and have created a general demand for closer tolerances. The fulfilment of these requirements can only be met by proper mill practice, suitable mill arrangement and the proper equipment.

The selection of the proper type of mill arrangement for a particular plant is important. This paper therefore discusses the continuous and semi-continuous type of merchant mills and points out their advantages.

In order to obtain an accurate product on either of the above types of mills, proper equipment must be available. This is even more true of the full continuous mill when the rolling mill stands are considered from the standpoint of rolling accurate rounds. The delivery of an accurate round from the finishing stand is dependent upon the delivery of an exact section from the next preceding stand of the mill and this section is in turn dependent upon the delivery of an accurate section from the preceding stands in the mill. In other words the accuracy of the finished product is a function, not alone of the finishing pass, but of each preceding operation. In order to assure this considerable skill is required on the part of the operator in the adjustment of the sections in the various roll stands. Since the product of the section area and the delivery speed must be a constant for all the roll stands it can readily be seen that an adjustment in section in any stand must be accompanied by a corresponding adjustment in roll speed. A section adjustment in one stand may require adjustments in some of the other stands both in section and roll speed. This naturally means constant vigilance on the part of the operators and a possible large scrap loss during the period of the proper setting of the various roll sections or passes.

It is in the maintenance of this accuracy and also in the relief of the operator from the necessity of constant pass readjustment that tapered roller bearings play an important part. The roller bearing does not show any wear as compared with plain bearings. By taking advantage of this feature it is possible to obtain perfect alignment and setting of the rolls and to maintain this setting indefinitely. It is also possible by proper design to make provision on the mill for adjusting devices which will permit setting the rolls or changing this setting by small increments in a minimum of time and without the cut and try method used on plain bearings. Once adjusted, the operator can be sure that the rolls will stay put and the only adjustments which he need consider are those required to compensate for wear in the roll passes. With this close control in the roughing stands as well as in the finishing stands a quality product is assured.

Since precision rolling is a matter of roll setting and pass alignment along with experience, the paper presents a number of layouts showing various devices which have been successfully used to adjust the roll passes in both horizontal and vertical mills. It also shows the successful methods of applying tapered roller bearings on roughing, intermediate and finishing mills.

Propane and Butane As Industrial Fuels

By E. A. JAMISON
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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

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These gases are pure hydrocarbons, Propane C_3H_8 and Butane C_4H_{10} containing a fractional percentage of Ethane C_2H_6 held mainly as dissolved gas. Propane and Butane are gases under normal conditions but are liquified at the refinery for ease in handling and storing. The major differences between these two hydrocarbons exists in their boiling points, vapor pressure and thermal value.

The present available supply of liquefied petroleum gas has been estimated at about two and one-half million gallons per day from both natural and refinery sources. About one million gallons of this total is butane from refineries which will eventually be absorbed into motor fuel leaving propane as the only material available from this source. There is being offered a small amount of a variable propane-butane mixture which, while inferior to the specification products, will be a competitor. The price of these gases is not expected to increase because of the large spread existing between the present supply and demand. In the middle west, prices have dropped from 7 cents to 3 cents per gallon, F.O.B., the refinery during the past five years. This occurred despite an 800% increase in consumption during that period.

Butane and particularly propane have been successful in displacing manufactured gas in almost every conceivable type of operation. One operation that should be of interest to the steel industry is the possible replacement of acetylene with propane. One large eastern steel casting concern reports their costs to be one-fifth to one-tenth of that of generated acetylene. Tests conducted in another large eastern steel mill indicate the replacement of acetylene with propane on a thermal basis with the same oxygen consumption.

These liquified petroleum gases are stored in A. S. M. E. fusion welded vessels in sizes ranging from 1350 gallons to 25,000 gallons which is the maximum allowable size under National Fire Protection Association Code. The liquid is transferred from truck to storage tank through special rubber hose by pumps, heat or air pressure. This equipment is especially designed for this service.

Propane, because of its low boiling point, is free vaporizing under almost all conditions while it is necessary to supply the latent heat of vaporization to butane from some outside source. Tubular heat exchangers or those of the flash type are used for this service. Liquid regulators maintain a constant pressure on the heat exchangers and secondary regulators on the outlet reduce the pressure to that desired in the plant. With propane these secondary regulators can be set between 25# and 50# while it

is necessary to mix air with butane in order to carry high pressure throughout the plant.

Undiluted butane and propane have approximately the same combustion characteristics of natural gas, however, the difference in gravity and B.T.U. value cause certain limitations on the type of equipment. Broadly there are three types of combustion equipment, low pressure, high pressure and atmospheric. The atmospheric type burner operates satisfactorily in a venturi type burner in about ten inches of water pressure where there is no restriction on the secondary air supply. The best low pressure type is one where the gas is reduced to a balanced or nearly atmospheric pressure. High pressure systems are the cheapest and simplest type to use but they are limited to either propane or air diluted butane. These systems generally operate at 20-30 pounds pressure.

Liquefied petroleum gas is transported in special tank cars constructed in accordance with the Interstate Commerce Commission regulations. The cars have a shell capacity of approximately 10,500 gallons which, when properly loaded, average about 9,600 gallons. These gases are also delivered by special tank trucks, hauling approximately 2,000 gallons. The trucks are equipped with pumps to take the place of the tank car unloading pump. These trucks open up a new field of industries whose gas consumption is not large enough to warrant a tank car size installation.

The National Board of Fire Underwriters have published Pamphlet No. 58, establishing a uniform set of regulations governing the design, installation and construction of containers and other equipment for the handling of liquefied petroleum gas. Because of the close adherence to these regulations the liquefied petroleum gas industry has been remarkably free of accidents.

In the east where propane is available from refineries the trend is definitely towards the use of propane rather than butane because of its many inherent advantages. During the past twelve months the Phillips Petroleum Company, who is the world's largest supplier of these gases, has signed ten (10) propane contracts to one (1) butane contract.

It is interesting to note that in face of the low production of industry that there was a 12% gain in the consumption of liquefied petroleum gas between 1931 and 1932, while there was a decided loss in volume in both the natural and manufactured gas industry.

Mechanical Billet Chipping

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

In getting up this paper, various methods and mechanical means for conditioning billets are referred to purely as an explanatory reference and they must **not** be construed as a reflection on anyone's individual efforts along lines of developments to produce a successful mechanical billet chipping unit. In the following are the principal items I expect to include in my paper:

1. Does mechanical chipping close up seams? This will, no doubt, be explained to the entire satisfaction of the listeners.
2. It has been said that billet chipping can be avoided in the open hearth. I met with one prominent superintendent who remarked that "we do not have any bad steel, but when we do, I immediately start out for the open hearth department demanding an explanation for the condition of the previous day's rollings." In spite of this fact, we still have to contend ourselves with billet chippers.
3. A 30-day survey of the airgun chipping method by one of the major steel companies reveals the startling fact that only 8 lineal inches are averaged with the airgun with an average width of 13/16".
4. As against this, we have records of mechanical chipping of from 125 to 150 square inches per minute of perfectly good, clean-cut surface by means of the billeteer principle.
5. This principle has a revolving head with six 2" wide cutting tools revolving at a speed of 6-2/3

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RPM, giving 40 cutting cycles per minute. Some of which remove 8 square inches per single cut. The depth of cut, of course, determines these square inch areas to some extent. The revolving cutting head or commonly called "milling

method" is accomplished by its great flexibility due to the spacing of the cutting tools. The tool can be raised or lowered, moved forward, or reversed while the head is revolving. The cut can be changed from 1/64" in depth to 3/8" between tool contacts with the metal. A skilled operator can readily place this tool over chalk lines without the slightest loss of time or unnecessary removal of metal.

6. The method employed in this unit enables the operator to stop any one of the six tools at the proper angle and thereby taking a planer cut with the proper rake of the tool. At the end of same, the head can again be started to revolve, thereby leaving a perfect taper so that no overlaps will occur in re-rolling.
7. The original stone-age methods of removing seams included the use of an ordinary hammer and cold chisel. The next step was a cold cutter and sledge hammer and finally the airgun method was employed for a number of years.
8. Since this time vast amounts of money have been spent in an endeavor to develop some method or means of mechanical processing of billets for re-rolling. This method will be thoroughly explained from sketches, etc.
9. The method of properly treating high speed cutters to obtain the best results.
10. Auxiliary equipment for charging and discharging billets to and from the machine.
11. The morale of chippers has been one of the most perplexing problems of the steel industry from the time of its conception. This is not entirely due to the disposition of the men themselves, but to the fact that this class of work is a most undesirable occupation.
12. Should billets be pickled or sand-blasted before mechanical chipping is done?

Electrical Equipment For High Speed Precision Merchant Mills

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

The past few years have witnessed major changes in the methods of rolling a number of steel products. The present methods of rolling beams, sheet, tinplate and strip are examples of the rapid evolution of rolling mill practices for some products. Meanwhile, a more gradual change in methods of rolling merchant mill products has been taking place. Fundamentally, the rolling of merchant sections is still an art rather than an exact science and the skill and experience of the roller plays an important part in the successful performance of the mill. Future development will necessarily come through greater emphasis on engineering analysis and less dependence on practical skill and cut and try methods.

Existing merchant mills are of many types and varieties. The tendency toward continuous high speed general purpose mills, so noticeable in other lines, has not become so pronounced in merchant mill practice. Because of the wide variety of material rolled and the frequecy of roll changes, mill equipment has been simple and even crude as compared with present equipment for many other products. The demand for greater accuracy of product and necessity of effecting production economies are making it imperative that merchant mills be provided with the most modern mechanical and electrical equipment. A considerable portion of present merchant mill capacity is now obsolete. The high speed continuous mill will very probably play an important part in future merchant mill development.

From the very beginning of the electrification of rolling mills the requirements of merchant mills have taxed the ingenuity of the electrical engineer. The simplest form of mill usually requires adjustable speed main roll drive. The A.C. adjustable speed motor has been developed almost entirely for merchant mill service and the D.C. adjustable speed motor has been materially improved to meet merchant mill requirements. Because of the accuracy of speed control required for accurate rolling at high speeds, special control equipment has been developed. Comparatively large vertical motors have been applied to edging stands. Considerable effort has been ex-

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pended in the development of precision stands which can be added to existing mills to improve the accuracy on rounds.

Disposal of finished product delivered at high speed presents a number of problems. Synchronized coilers and conveyors with special speed characteristics will handle material which can be coiled. Material which is delivered to a hot bed can be handled to advantage if cut to lengths when leaving the finishing stand rather than when the billet leaves the furnace. Automatic electric flying shears interlocked with automatic control for operating the hot bed permits accurate shearing at speeds which would be prohibitive with all or part manual control.

New Developments In Lubrication

By G. W. MILLER
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Paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

Years before any one of us can remember, someone discovered that by adding wheels to the conveyances then in use heavier loads could be transported with greater ease and less power. Further discovery was made that the use of fat or suet, or even the liquid from certain vegetables applied to the point of friction between the wheel and axle further decreased the amount of energy required to move the load and, in addition, the wheels and axles lasted longer—lubrication was the secret.

Mechanical genius added to this first invention, but it was not until crude petroleum was discovered that the mechanical engineer was able to produce real efficient, labor saving mechanical devices that would operate without constant attention and repairs due to wear caused by the lack of proper lubrication.

The petroleum industry grew in leaps and bounds, especially after the first automobile made its appearance. At first, like in all new industries, very crude methods were used in the refining and manufacture of the various grades of lubricants. Improvements were made up to a certain point and refiners sat back contented. The lubricants they were manufacturing were as good or better than required at the time. Mechanical conditions changed—better lubricants were required.

It did not take the lubrication engineer long to step into the breach and do some real constructive work—work that not only brought lubrication up to date, but improved the operation of mechanical devices and gladdened the hearts of operators by reducing maintenance, power consumption and lost time due to repairs.

We will go into these improvements step by step from the refining of crude to the manufacture of lubricating specialties.

In the old days, crude oil was placed in a still, heat applied and the various fractions or grades of lubricants distilled or vaporized off. These were put through successive operations to remove certain undesirable ingredients and to improve their appearance. With the advance in mechanical design, lubricants that would stand greater heat and pressures, freedom from corrosion and sludging were required.

This lead to improved vacuum distillation, which resulted in better oils and, incidentally, reduced cost in refining methods.

Later developments have been the hydrogenation of crude. In this method, the crude is refined in contact with hydrogen, which results in more stable

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lubricants. Hydrogenation gives the refiner a closer control over the type of product he wishes to make. In other words, he can make his runs of any particular type of lubricant or fuel almost at will, turning fuel oil into gasoline, running for straight lubricating oil of any desired grade, etc.

The Mercury method is another method lately developed for closer control in both refining cost and the production of higher quality more uniform lubricants. The crude is refined under a vacuum system heated by mercury boilers. The claim is that closer heat control is obtained, resulting in better products.

The latest development in refining is the solvent method. Of all the methods, we believe the solvent method produces the best lubricants.

With the introduction of solvent refining, a new tool has been made available to the refiner to aid in producing better lubricants. Solvent refining operates in accordance with chemical and physical laws which differ greatly from those which govern distillation. The refiner with this method can sort out the

type of hydrocarbons in the crude to obtain the best results in the finished product. In this method, certain solvents are added to the crude. Before refining, the solvents which are not soluble in the crude, but which do pick up or dissolve certain parts of the crude, are separated, leaving the desired portion to be further refined and completed.

This all means that to date various methods have been developed that greatly improve the quality of the products in use today.

However, improvements in lubrication does not stop here. We have only mentioned refining developments that are turning out cleaner, longer life oils. What has been done to make these oils real lubricants?

It is a well known fact that some oils give better lubrication than others. The answer to this is the fact that one oil contains more "Oiliness" than the other. "Oiliness" is defined as that property of lubricants by virtue of which one fluid gives lower coefficients of friction than another fluid of the same viscosity. "Oiliness" under practical operating conditions is of greater importance than is generally recognized.

It has been known for years that the least refined of petroleum oils, provided certain detrimental qualities are not too outstanding, are in general better lubricants than the same oils highly refined. This is due to the fact that there is naturally contained in crude oils bodies which enhance the lubricating value, but which have been wholly or partially destroyed in the more modern methods of refining to obtain cleaner and more stable lubricants.

Study, in part at least, has been made of the peculiar qualities in those bodies which impart the oiliness observed. It has also become possible to manufacture from crude oils themselves, bodies which have the properties of those contained in the natural crudes, finally to add these bodies to the oils so that the "Oiliness" lent to mixtures with petroleum oils is much beyond that which can be produced by any kind of refining.

With these natural crude oil bodies, friction under full fluid film lubrication can be reduced as much as 50%, which means a tremendous saving in power consumption. At the same time, it is possible to lend to the oils the ability to resist film rupture even under pressures that go far beyond that of normal bearing design and construction. The same materials lower the surface tension of the oils while increasing their affinity for metal surfaces. Similar results in oiliness have been obtained by adding fatty oils such as oleic acids to mineral oils. However, far superior results have been obtained by the use of the straight mineral oil bodies without the attendant dangers always present when using fatty oils. A book could be written on the results obtained in the lubricating field from the use of these "Oxygenated" process oils over straight or ordinary mineral oils.

Oils of much lighter viscosity can be used, which further decreases the power cost and increases lubricating efficiency.

The oils are more stable, almost entirely free from emulsification and entirely free of gumming. In fact, they will remove the gummy residue generally found in bearings and allow fresh lubrication.

The use of steam cylinder oils of this type will keep valves and ports absolutely free of gum and carbon. In air compressors, or blower engines, carbon menace is removed entirely. Bearings and cylinders run at greatly reduced temperatures. Further, this type lubricant adheres to the metal surfaces and does not drip off, eliminating dry starting, which is the greatest cause for wear and power load.

These statements are not mere fancy or laboratory dreams. Many commercial tests over long periods of time have shown unbelievable results, but our time and space is too limited to go into detail.

These "Oxygenated" products, although developed only two years ago by our research staff, have won great favor over ordinary mineral oil. We might add this same process is also applied to the manufacture of solid or semi-solid greases.

Another development which we wish to touch on has to do with cold weather lubrication. We all know that congealed oil means wear and great power consumption. Of the two general types of mineral oils, namely paraffin and asphaltic, the asphaltic type flows at low temperatures while the paraffin forms a jell. It has been proven that while the asphaltic oils flow at low temperatures, the internal friction and drag of these oils at the reduced temperatures are tremendous, while although in jell form, the internal friction or drag of the paraffin oils is only slightly increased. Of course, there is the danger in the jelled oil channeling and stopping lubrication.

Thanks to the work of the petroleum technologist, the superior lubricating quality of paraffin oils can be had along with the desired ability to flow freely at temperatures as low as minus 30 and 40 degrees F. This desired quality is obtained by the addition of paraflow. Paraflow is a product of the research laboratories of one of the large development companies and was first offered in the fall of 1931. Paraflow treated oils are now available through licensed refiners and compounders.

Paraflow is a specially processed mineral oil quite extraordinary in its effect on oils with which it is blended, reducing their pour points and drag to a remarkable degree without impairing lubricating value or otherwise changing their properties.

The manufacturer of paraflow is rather complicated, involving chlorination in the presence of anhydrous aluminum chloride as catalyst and in appearance is a heavy, dark colored semi-solid mineral oil.

As little as half of 1% of paraflow will reduce the pour point of an oil as much as 45 degrees. In other words, a paraffin oil that will jell at plus 35 degrees F. will flow freely at minus 10 degrees F.

The reaction is due to the fact that paraflow prevents the formation of a crystalline structure at low temperatures, keeping the oil in a full fluid condition. Tests have also shown that the addition of paraflow will aid in reducing the viscous nature of asphaltic oils at low temperatures.

The facts presented only give you the surface of what has been done in our own and other research laboratories to improve lubricants and lubrication.

Theory and Practice of Immersion Heating With Gaseous Fuels

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

In my paper I will briefly summarize the age old practice of external heating of salt and metal baths. I will outline the development of immersion heating, the evolution of equipment for the purpose, the general advantages and conclude the paper with performance comparisons on four distinct types of operation, and a plea for greater co-operation between heat treating industries and the manufacturers of specialized heating equipment.

With external heating, I will point out, heat transfer is restricted by three factors; limitation of heating surface, heat distribution in the mass and radiation losses from the pot surface and brick work, which together make accurate temperature control difficult if not impossible.

Other difficulties commonly encountered are short pot-life, excessive surface oxidation, retarded production and oppressive working conditions.

Kemp research in this field reaches back many years and as early as 1916 the first experimental work with gas-fired immersion heating was done using solder baths and other small heating appliances. Out of these experiments came the knowledge of the controlling factors and a realization that the primary requirement was a complete control of the fuel which could only be secured by complete pre-mixing of the air and gas.

Through years of study and experience with hundreds of immersion applications a heating element of the recirculating type has been found most efficient since the high velocity flame entrains a portion of the cool products of combustion thus tempering the flame zone and preventing local overheating of the element walls.

The shape of the heating element may be varied considerably to adapt it to the shape of the container and the requirements of the job. Similarly the size of the elements, the number employed and their location in the pot are individual problems with each job, but experience has shown, as the examples quoted in my paper indicate, that immersion heating with gas has reached a point where requirements may be accurately met and controlled.

Actual practice has shown that immersion heating presents the following general advantages over external heating.

1. fuel economy
2. temperature regulation
3. heat distribution
4. dross reduction
5. increased container life
6. improved working conditions
7. increased production

which points are discussed in some detail by the author.

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As examples of immersion heating advantages, the author presents experiences in four different fields:

1. A tin-plate manufacturer in going to immersion melting increased production 13 per cent using 18 cu. ft. of gas per base box as against 42 cu. ft. with a temperature variation of plus or minus 2½ degrees F. as compared with 15 degrees, and cut his dross formation 75 per cent.
2. In more than eighty newspaper plants, immersion melting of stereotype metal has cut gas consumption from 40 to 73 per cent.
3. A can manufacturer using immersion melting in the solder bath of automatic side-seamers cut gas consumption from 190 cu. ft. per hour to 92 cu. ft., and secured freedom from leakers with proper solder wiping.
4. A wire manufacturer employing immersion heating in salt bath heat treating increased production 60 per cent and cut gas consumption 50% per ton of production.

Looking into the future of immersion heating, I see new fields to conquer, a wide range of usefulness. Hot galvanizing and steel finishing in general I regard as the next important fields. But I state frankly, that the advance of immersion heating is dependent to a large extent upon the co-operation that these industries are willing to extend.

Nitrogen In Metallic Arc Weld Metal

By DR. J. W. MILLER
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An introduction to Dr. Miller's paper by Dr. P. P. Alexander, Thomas Research Laboratories, General Electric Company, Schenectady, N. Y.

More than three-quarters of the atmospheric air consists of nitrogen, therefore, it is very necessary to know how this element affects welding, and perhaps it will be useful to review briefly what steps were gradually taken during the development of the art of electric welding to bring under control the powerful effect of that gas on the welds.

Metallic arc welding was originated in 1890 by H. Slawianoff. Being a metallurgical engineer with a thorough knowledge of electrical engineering, he was able to appreciate the electrical as well as the metallurgical side of electric welding. In a short time he was able to develop arc welding to a high degree of practical perfection, and under his direction it was used on production work. An automatic arc welding machine of his design was put into use in the factory for welding steel and even copper pipes. Furthermore, adequate fluxes for each type of material were used since he was using a welding current ranging from 600 to 800 amperes. With his untimely death, the work was stopped, and arc welding in Russia became a lost art. However, this work was again taken up, especially in England, and soon developed into a fine art of arc welding with fluxed electrodes and comparatively low currents of 100-150 amperes.

In this country arc welding achieved general development during the World War. Many concerns answering the requests of the war needs (especially in the field of rapid construction of the amergency fleet of transport and cargo vessels of every kind) soon adapted the art of welding to local conditions and evolved a system of welding with bare electrodes.

This change from the fluxed electrode to the bare wire electrode system was due to two factors:

1. Because accurate tests indicated that there was no appreciable difference in the quality of the welds produced with the fluxed electrodes available at the time, and welds made with a good grade of bare wire.
2. Electrical engineers were soon able to develop such arc welding generators as would give a perfectly stable welding arc without the additional stabilizing effect of the flux.

This American system of welding with bare electrodes is entirely satisfactory for many purposes, and for many years it was used almost exclusively in this country.

As time passed, electric welding was continually extended to the fields where welds had to possess, not only strength, but also high ductility, resistance to shock, corrosion, etc.

Metallurgists discovered in arc welds the presence of nitrides of iron which exerted a powerful effect on the quality of the weld. Nitrogen in welds increased to a certain extent their tensile strength, but at the same time reduced their ductility.

Pioneer work in this field was done by S. W. Miller of the Rochester Welding Works and W. E. Ruder and G. R. Brophy of the General Electric Company. Later it was taken up by other investigators, among whom were the Bureau of Standards, Dr. Henssel of the Westinghouse Company and finally Dr. J. W. Miller.

The presence and the effect of nitrogen on the welds was established. It was now a problem of controlling, and when necessary, of counteracting the effect of nitrogen. Here again the American metallurgists and electrical engineers made a notable contribution to the art, and in fact brought it to such a state of development that it can now be used on such structures as high pressure vessels, certain parts of steam turbines, gun carriages and other articles used in ordnance or naval constructions which are subjected to high pressures, or alternating stresses and repeated shocks.

One system of protection from nitrogen consists in surrounding the arc and the weld by an envelope or a jet of hydrogen gas. The well-known Atomic Hydrogen Process is one of the methods of eliminating excessive amounts of nitrogen in the welds. Another system of protection consists in providing the electrode with a heavy covering of flux which eliminates to a considerable extent the possibility of contact of the surrounding nitrogen with the arc and the weld.

Pioneer work in developing and applying this system to the welding of heavy pipes and pressure vessels on a large scale, was done by the A. O. Smith Corporation, Babcock and Wilcox Co., and others. Of course a great number of other concerns and independent investigators were conducting independent developments, so that now a number of concerns produce excellent heavily coated electrodes which have advanced the American welding industry to a foremost place in the art.

A survey of the technical literature indicates that a number of investigators are at work on precise investigations of the nature of the arc, the mechanism of formation of the arc crater, temperature of the arc and the effect of various factors on the stability of the arc, effect of the polarity, the type of electric current, etc.

Since the electric arc is the tool with which the welds are made, one must know its nature and peculiarities in order to use it with a maximum of efficiency.

It is well established that the conduction of the electric current in the arc is an ionic phenomenon and that most of the current is being carried by the electrons. Yet without the continual production of positive ions in the arc stream, the arc phenomena would be impossible. The facility with which the atoms and molecules of gases and vapors, which may happen to be in the space between the weld and the electrode are ionized, will have a very marked effect on the temperature of the arc and its stability and

distribution of energy between cathode and anode. And these factors will greatly influence the facility with which nitrogen of the air will combine with the materials present in the arc and therefore determine the quality of the weld.

The ionizing potential of oxygen, nitrogen, iron, titanium, calcium, sodium, and potassium, are respectively 13.5, 10.8, 7.4, 6.5, 5.1 and 4.1 volts. This suggests immediately that if the vapors of alkaline earths or alkali metals are present in the space between the electrodes, striking and maintaining the arc would be much easier than in air. In selecting the flux, one should also consider its effect on the distribution of energy in the arc. As every electrical engineer knows, in an electric arc maintained between carbon electrodes, three-quarters of the energy is liberated at the anode, almost one-quarter at the cathode, and only a very small amount in the arc core.

In case of an arc maintained between a steel plate and a carbon electrode or between a steel plate and a metallic electrode, the distribution of energy is entirely different. In the latter case the energy liberated at the cathode is about equal to that of the anode. Furthermore, its distribution can be greatly influenced by the fluxes. For instance, such fluxes as $NaFe(SiO_3)_2$, $FeSiO_3$, $CaMg_3(SiO_3)_4$, Al_2O_3 or MgO would increase the amount of energy liberated at the cathode. The first-named flux used on one commercial electrode will create conditions under which 60% of the total energy of the arc will be liberated at the cathode. For this reason the manufacturers of that electrode recommend the use of reversed polarity, otherwise the electrode would melt too fast and the penetration would not be sufficient.

Other fluxes such as CaO, TiO_2, and Na_2O would have the opposite effect, that is, a larger percentage of energy would be liberated at the anode. The temperature of the arc could also be influenced by the proper selection of the fluxes.

Turning now to the question of how, and in what part of the arc nitrogen unites with iron, one must first of all remember that molecular nitrogen does not react with molten iron. In the Bessemer Process, tens of thousands of cubic feet of nitrogen are blown through every ton of molten iron, and yet the increase of nitrogen contained in the produced steel is small.

To become chemically active, nitrogen must be in the atomic state. Yet to produce atomic nitrogen, it requires three times as much energy as in the case of atomic hydrogen, namely, 274,000 calories per mol as against 98,000 calories per mol of hydrogen. Furthermore the dissociation of nitrogen into the atomic state does not begin until the temperature of 3500° C. is reached, whereas the dissociation of hydrogen is appreciable at 1900° C. This indicates that the contamination of iron with nitrogen can occur only at the arc core, that is, either along the arc core in the arc stream or at the foot of the arc core at the "cathode or the anode spot" in each crater. If the arc core is short, and therefore more easily protected from the contact with nitrogen, then there is hope that the weld will contain a small percentage of nitrogen even if the gas does come in contact with the molten metal in the crater.

It would seem that a further study of such factors as the composition of the fluxes, influence of the polarity, and the type of current used, always followed by the metallographic investigation of the deposited metal, will be very useful and would lead to immediate appreciable results.

DR. J. W. MILLER

Abstract of paper which Dr. J. W. Miller is presenting at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

During the course of the investigation it was found that the nitrogen content of weld metal deposited by the metallic arc process might be diminished by:

1. Increasing the carbon content of the electrode.
2. Increasing the amperage.
3. Decreasing the arc length (voltage).
4. Increasing the diameter of the electrode.
5. Decreasing the nitrogen content of the atmosphere.
6. Using heavily coated electrodes.

It was found that nitrides might precipitate at the grain boundary or within the grain itself and might also cause widened grain boundaries.

It was found that the needles present in arc weld metal are probably the gamma prime phase of the iron-nitrogen system and correspond to the compound Fe_4N. The colorless, structureless areas found in arc weld metal are probably ferrite areas which are rich in iron-nitride that has not had sufficient time to segregate in the form of needles.

The main oxide present in weld metal is the magnetic oxide of iron which is commonly known as "magnetite."

It is the opinion of the author that carbon-monoxide and hydrogen, with perhaps the assistance of hydrocarbons, are responsible for the blow holes occurring in weld metal deposited by the metallic arc.

No difference in the nitrogen content of the deposited weld metal was found in the welds produced by annealed and hard drawn electrodes.

It was found that conditions which lead to the absorption of nitrogen are conditions which lead to the burning out of carbon and the contamination by oxygen.

When straight polarity is used, the nitrogen is absorbed at the tip of the welding electrode. When reversed polarity is used, some nitrogen is absorbed at the tip of the welding electrode, some is absorbed by iron when passing through the arc, and some more is absorbed by the metal in the crater of the arc. The carbon is eliminated at the time and under the conditions under which nitrogen is absorbed.

There was evidence that the nitrogen, in an air atmosphere, is probably fixed as nitric oxide (NO) in the cooler part of the arc and this is probably split up into active atomic nitrogen and oxygen, both of which may react with the metal.

At the elevated temperatures of arc welding, the solubility of nitrogen in iron decreases with an increase of temperature.

Conditions which lead to an increased absorption of nitrogen in the weld metal are conditions which lead to a decrease in the values of the physical properties of the weld metal.

It was found that nitrogen alone will not account for all of the inferior properties found in some metallic arc weld metal. It is the author's opinion that other factors such as heat treatment, grain size, microstructure, carbon content, manganese content, oxygen content, etc., play an exceedingly important part in controlling the physical properties.

Developments In Welding

By G. A. HUGHES
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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

G. A. HUGHES

The past year has brought about some remarkable advances in both the art of welding and new equipment. Some of these are briefly described herein.

A. C. Welders

Widespread interest is being shown in metallic arc welding with alternating current, particularly by the fabricators of tanks, pressure vessels and heavy steel plate 5/8" thick and above. One of the outstanding advantages of A. C. welding is the almost total absence of magnetic arc blow due to a minimum amount of residual magnetism being built up in the steel plate. This in turn means less porous weld metal. Other advantages include the low ratio of short circuit to normal welding current, usually not exceeding 108%; low no load losses; relatively high efficiency, less maintenance due to no moving parts and less weight.

Electrodes

New shielded arc electrodes now give
Tensile—65,000 to 75,000 lbs. per sq. in.
Elongation—20% to 30% in two (2") in.

These electrodes may be used in any position flat, vertical or overhead, giving same results.

The new and varied uses of the stainless steels have, by necessity, created practical and economical means of fabrication. In addition to the resistance welding method, some marked progress has been made in a system employing a helium shield around the arc. Good uniform welds are being made at speeds of 50" per minute on certain kinds of light gauge stainless steels.

One of the more recent developments in welding equipment is the various methods of regulating welding current (amperage) and stopping and starting of the driving motor from the welding position. Such schemes are generally known as remote control and enable the operator to adjust the welding current or stop and start the motor without returning to the welding set—the ultimate purpose being one of convenience and economy to the users.

Resistance Welding

With the advent of accurate timing of welds a new field of application has been opened up to spot welding—a branch of resistance welding. Heretofore, spot welding has been largely confined to the ordinary steels where mechanical timing devices and their inherent lag and inaccuracies were satisfactory. The welding of dissimilar metals, those of high thermal conductivity, special alloys, stainless steels,

aluminum and all light materials requires short and accurately controlled timing of each weld so made. This is now accomplished by the electronic tube control which permits the localizing of welding heat to the immediate weld vicinity and precision timing thus assuring extremely uniform welds.

One of the large automobile companies is flash welding flat sheets 144" in length in order to press the entire body from one piece.

Resistance welders making six different welds simultaneously, all the different parts of the body are placed in this welder and every seventy (70) seconds a complete body is taken out of the machine.

Load Factor and Power Cost—A Danger and A Possible Answer

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

1. Meters used for the purpose of determining the amount which a user of electric service shall pay for that service, should be above suspicion as to accuracy in so far as it is humanly possible to make them. For this reason, the block interval type of demand meter now in almost universal use in the United States is unsuitable due to its large factor of indefiniteness. This indefiniteness may be avoided by the use of other types of demand meters.

2. Load factor, to determine which demand meters are used, is of prime importance in determining cost of service and should be recognized to even a higher degree than in most existing rate schedules.

3. In the case of domestic loads, the recognition of load factor on the basis of some measured quantity instead of an estimated quantity, as is now almost universal practice, would be preferable.

4. The recognition of load factor by the method of measuring excess k.w. hours is suggested for consideration.

PAUL M. LINCOLN

Thermit Welding—Its Economic Importance In Steel Mill Maintenance

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

The thermit welding process is based on the alumino-thermic reduction of iron oxide. Reaction time and resultant temperature may be controlled by the addition of metallic elements to the thermit mixture, which is generally composed of Fe_3O_4 and finely divided aluminum. In designing thermit mixtures for welding, there are sufficient variables to permit not only close control of the speed and temperature of the reaction, but also the physical properties of the weld metal.

Welding by this process is a simple operation. It requires no extensive training, no particular manual dexterity on the part of the operator. In making a weld, it is necessary only to follow a few simple rules.

The inherent advantages of the process, particu-

larly in the repair of very heavy sections of ferrous metals, have led to its almost universal adoption by the iron and steel industry for the maintenance and emergency repair of machinery and equipment. Approximately 80 per cent of the country's steel mills use this type of welding for this purpose.

The widespread acceptance of this manner of welding is primarily due to three outstanding factors. First of these is the low cost of repairs in contrast with the cost of new parts for replacement. The second is the speed with which repairs can be made, as compared with the length of time required to obtain and install new parts. Third is the dependability of the welds made and the fact that these repairs are permanent. The first of these two factors are of genuine economic importance in steel mill operation. They provide the superintendent and master mechanic with a low cost method of meeting emergencies. They prevent long and costly shutdowns of whole departments as well as prolonged periods of reduced output for entire mills when essential equipment breaks down.

The dependability of these welds, and the permanence of repairs, hinge largely upon the high quality of the steel produced by the thermit reaction. It has been proved, both by innumerable tests and in actual service, that this steel has physical properties which are the equal in every respect to those of high grade steel forgings.

In general, there are three uses for this type of welding in the steel mill. These are:

1. The repair of broken parts which may be indicated for economic reasons such as the low cost as compared with replacement, or the saving in time in getting the mill or machine in operation again.
2. The building up of worn parts, which in many cases replaces the metal worn away with one far better suited to withstand the service.
3. The manufacture of new constructions or the making of old ones in a new way.

Actual applications of the process include the repair of rolls and pinions, the building up of worn pods, the repair of housings, crankshafts and many other parts too numerous to mention here.

Greatest benefits are derived in mills where regular thermit welding departments are established. These departments are not limited to the making of emergency repairs, but undertake routine repairs of all kinds such as the salvaging of parts from the scrap pile and converting them into spares. Lists of the day to day activities of such departments reveal their important contribution to every branch of steel mill operation.

Factors Affecting The Circulation of Oil

By MAURICE RESWICK
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Paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

Forced feed lubrication is now recognized as the most efficient method of bearing and gear lubrication in the steel industry. Steel mill machinery of today is designed and built more and more along the lines of precision, accuracy, close tolerances and for continuous production. More efficient lubrication by means of circulating oiling systems had to be developed for the successful operation of modern machinery.

The primitive type of a bearing was designed for casual lubrication with a squirt can through a hole drilled in the cap. A waste packed bearing holding a supply of oil which is delivered to the journal by capillary action was the next step in approaching continuous lubrication. A sight feed oil cup, so adjusted as to deliver a drop of oil at infrequent intervals on the journal before the lubricating film between the journal and the bearing became impoverished, was a further improvement. A close approach to the maintenance of a rich continuous lubricating film without waste of oil, is found in a ring oiled bearing, the only draw back being that a limited supply of lubricant is available in the oil well where it is subject to contamination with use.

The closest approach to perfect lubrication is attained in forced feed systems, which supply the wearing surfaces of bearings and gears with cool and clean oil from a central reservoir of ample capacity. The function of a circulating system is not only to lubricate the parts of machinery in sliding or rolling contact, but also to carry away the heat from the friction surfaces, and avoid abnormal operating temperatures which might soften the babbitt in a bearing or draw the temper in ball or roller bearings.

The correct lubrication of gear reduction units and pinions is a major problem in steel plants. On older installations a heavy pitch-like grease or gear-shielding compound was recommended for the gears and a comparatively light viscosity mineral oil for the bearings. In spite of the great care given to isolate the gears from the bearings, contamination of lubricants takes place—the gear compound becoming gradually lighter and the bearing oil heavier in viscosity. The gear cases heat up on account of the churning of the excess lubricant in the case, while the operating temperature of the bearings rise due to the greater friction with the thickened oil. The latest approved and preferred practice is to use the same lubricant on both gears and bearings, applied by means of a circulating system, delivering the oil to the bearings in a continuous stream and to the mesh line of the gears in a continuous spray.

Parts of Circulating Systems

A superficial inspection of any circulating oiling system impresses us with the fact that it consists of essentially two complementary systems—the **pressure system** from the discharge end of the pumps to the point of delivery of the oil at the bearings or mesh

line of the gears—and the oil return, or **gravity system** embracing all pipe lines or drains from the machine lubricated to the return tank. The principal difference between these two complementary systems is that the first one is operated on the pressure principle, while the second is depended on gravity flow only.

Reconditioning of Oil

An integrated part of the circulating oiling system is the lubricant reconditioning equipment. Foreign materials, such a metallic particles picked up from the bearings, gears, scale from gear cases and pipes, water, grit from atmosphere, etc., must be removed from the body of the oil circulated. The process of removal is based on the difference in specific gravity between the insoluble contaminants and the oil.

Accelerated action in clarification is obtained by passing the oil through a centrifugal separator where it is whirled at high speed, developing a force as high as 15,000 times that of gravity. Heating the oil to lower its viscosity assists this separation, after which it is cooled to normal temperature.

Filtration through fabrics or fine metal gauze screens has long been a favorable method for removing impurities from circulated oil.

Reconditioning of the circulated oil may be accomplished by any of the following three methods: (1) Batch purification, where the entire quantity is cleaned periodically; (2) partial or by-pass purification where the oil is pumped to the cleaning device continually from the return tank and returned to the tank; (3) total filtration where all the oil pumped to the bearings and gear is forced through filters.

Design Features

A circulating oiling system, being made up of many mechanical and electrical devices, is subject to getting out of order, although this is generally taken care of in allowing liberal factors of safety and by providing duplicate pumps, which may be considered as the heart of the system, together with protective signal alarm devices, which may be considered as the nerves of the system.

As a further precaution against temporary shut downs for repairs of the system, in the best designs the bearings are provided with oil rings to enable the bearings to carry on for at least 30 minutes. Similarly, the level of the lubricant in the gear case is maintained to about ¾ of the depth of the teeth of the larger gear so that temporary lubrication, or rather emergency lubrication, however partial, may be maintained until the source of the trouble is ascertained and remedied.

Where the nature of the lubricant is such that all churning in the gear case is to be kept at a minimum, by draining it as quickly as possible from the bottom of the case, the pressure supply tank should be of extra capacity so that even should the minimum air pressure be reached, there will still be sufficient lubricant in the pressure supply tank to feed the meshing gears and bearings until the mill has been able to finish rolling the material already started through. Electric alarm gongs should be provided on the pressure tank to indicate abnormal level of lubricant in the pressure tank.

MAURICE RESWICK

A well designed circulating oiling system should be fool-proof against accidental tampering, particularly in and around the return lines and the return tanks. Shut off valves and drain cocks should be conspicuous by their absence. The writer recalls a sad experience in a mill where one of the laborers who was cleaning out the pit about the return tank inadvertently opened a valve with the result that some 3,000 gallons of oil found its way into the sewer and the mill was put out of service for two days until a fresh supply of oil could be delivered. Instead of valves, pipe plugs and bolted covers should be used at this vulnerable spot of the system. Where valves are in use, these should be locked up and the keys handed to authorized persons only.

Pressure Lead Lines

Detailed discussion of the pressure end of a circulating oiling system may be cut short for the reason that in practice we can always increase the pumping capacity or raise the pressure sufficient to cause satisfactory flow of the oil under normal conditions. Only a few general remarks pertaining to the pressure end will be made.

The size of the lead pipes should be as liberal in diameter as good design may permit. Wherever possible gradual bends should be resorted to in place of sharp elbows or turns. The pipe nipple from the sight-feed device to the bearing cap oil inlet should be preferably over ½", because from the sight feed to the bearing the oil flow by gravity and a small size pipe nipple may cause too much resistance to the flow of oils which may be of necessity of a high viscosity. Some means of ready inspection should be provided to ascertain whether or not the multiple

spray outlets inside the gear case are all functioning and are not clogged up with sludge and dirt accumulations. The flow indicators of the vane type on the oil lines leading to the gear sprays give only a visual indication that the oil is in motion—some metering device to indicate the volumetric flow would be more reliable, and the suggestion is made that manufacturers of oiling systems give some thought to this matter.

Gravity Return Lines

Our attention will be directed to a detailed study of the gravity or oil return system where critical limiting conditions exist. Gravity is the only actuating force to handle all the oil from the pressure end, and imposes limiting conditions which cannot be satisfactorily surmounted by any forced mechanical means.

At first thought the installation of suction pumps at the gear case oil outlets may appear to be as one means of getting away from the dependency on gravitational flow. The objection is that with suction pumps running at constant speed and of a capacity to take care of the maximum flow there will be considerable idling of the pump and excessive agitation and aeration of the oil, as the suction end must be open to the atmosphere if the sucking out of all the oil from the gear case is to be prevented. This churning will accelerate oxidation, emulsification, foaming and sludging of the circulated oil. Where several gear units are fed from the same system an unbalanced condition of turbulence will be created in the return system, which might tend to make conditions still worse.

Drain lines from gear cases, and also from bearings where not otherwise taken care of, should be provided with goose neck bends adjustable for the maintenance of the proper level of oil in the gear case. A straight by-pass with the shut-off valve should be provided at the goose neck for draining the oil out of the gear case when required and also to assist drainage temporarily in cold weather when the oil becomes sluggish before it is sufficiently warmed up for unassisted flow through the goose necks. When viscous gear lubricants are circulated, difficulty in the return of the oil to the tank may be increased through the use of goose neck piping. In such cases reliance should be placed on extra capacity in the pressure tank. Vent pipes should be installed at every goose neck to prevent the formation of air pockets at the top of the bend.

Every gear case should be vented at the top to permit the escape of the heated air inside the case and to release the pressure generated inside the gear case due to the pumping action of the gears, the volatilization of the oil and the expansion caused by rise in temperature. If this pressure is not released, it may cause the oil level in the gear case to become depressed, so that the teeth will not dip in lubricant as an additional lubrication safety provision.

Under the limiting condition of gravity flow in the drain lines, the design should be such as to provide as much slope in the pipes as possible, to make them of liberal diameter and of as short a length as correct arrangement of the lubricating system may permit. For example, while a 4″ dia. pipe over a distance of 50 feet and having a slope of 2 feet may be proper for a straight mineral oil having a viscosity of 500 secs. Saybolt Universal at 100°F, when a heavier oil is meant to be used, say one of 2200 viscosity, the drain lines should be at least 6″ diameter with a slope of about 3 feet. In general, to be on the safe side, always specify as large a diameter for the drain lines as consistently possible.

Under the limiting conditions of gravitational flow, the resistance offered by sharp bends should be held down to a minimum. Instead of 90° ells, pipe bends of as large radius curvature as possible should be used. Pipes larged than 6″ in diameter which cannot be readily bent, should be built up out of 5 sections by welding to obtain a 90° bend.

Where drain pipes from several separate machines are branched into the main drain line to the return tank, instead of a right angle tee connection a 45°Y connection should be used, with the acute angle in the direction of the flow. Of course, the size of main drain line should be enlarged as more drain lines branch into it.

Particular precautions must be taken where a branch drain line is taken from an elevated point, such as from the screw down mechanism of a rolling mill, discharging into the main drain pipe. The high fall of the oil from the top of the mill may cause excessive disturbance in the main drain pipe. If the return tank of the circulating oiling system is not too far from the roll stand, it may become advisable to drain the oil from the screw down mechanism direct into the tank.

Properties of Mineral Oils

Not all lubricating oils are suitable for use in a circulating system. During the process of pumping, circulation through the pipes churning and agitation in the gear case, the oil is subjected to considerable punishment, and must, therefore, possess certain characteristics to withstand these actions. The desirable properties in a good circulating oil will be enumerated, and such departures from the ideal as may become necessary will be noted. Brief definitions of technical terms will also be given, it being understood that more detailed elucidation may be obtained by those interested from any good reference book on lubrication or from the literature available through the major oil companies.

Viscosity

First of importance is to have an oil of the correct viscosity under the operating conditions of temperature, pressure and speed. Viscosity is a measure of the "body" or the relative fluidity of the oil. Viscosity is also a measure of the internal friction of the lubricating film, that is, the resistance to motion offered by the molecules to shear while sliding over each other. A high speed bearing requires an oil of low viscosity, say 200 seconds Saybolt Universal at 100°F. A heavily loaded bearing operated at a speed of say 300 r.p.m. would require a heavier oil, say 500 secs. A moderately loaded gear set would

work best with a circulating oil having 3,000 secs. Saybolt Universal at 100°F.

In a double reduction gear unit. designed for lubrication with the same oil at all points, all of the above conditions are found. It is obvious that some compromise must be reached to determine the average viscosity. Practical experience has shown that a happy medium is reached when the viscosity of the oil selected is within the range of 900 to 1,500 seconds Saybolt Universal at 100° F.

The governing factor is the minimum viscosity of the oil for the gears, and where it is felt that the viscosity may not be heavy enough to resist the tooth pressures, a more copious spray on the teeth is provided, on the theory that the time interval during which the teeth are in contact is so short, that the inertia of the mass of oil between the meshing teeth prevents the lubricating film from being broken up, and that the surfaces in contact are separated by a fluid lubricating film. In extreme cases a special lubricant possessing extra film strength should be used.

So far as the bearings are concerned, those on the slow speed side will operate with a 900 or 1,200 viscosity oil about as well as they would with a 500 viscosity oil, for the reason that performance latitude of lubricating oils is quite wide, but the high speed bearings on the motor side will certainly run warmer than if the ideal 200 viscosity oil were used, and here the factor of safety of the bearing itself, that is, of the materials entering into the construction of the component parts of the bearing, such as roller bearings or type of babbitt, must be fallen back on for the continuous successful, although somewhat warm, operation of the bearing. Attention should also be given to the radiation and dissipation of heat unavoidably generated in such bearings.

Low Temperature Properties

The relative fluidity at low temperatures of an oil for use in a circulating system should be given consideration. Two oils of the same viscosity at 100°F. at the operating temperature will have different viscosities at 32°F., some oils becoming "solid", or will not flow at even 60°F. Other things being equal, an oil having the best cold and pour tests should be selected. Modern refining and treating methods have during the past few years been so improved that oils having excellent low temperature characteristics over a wide range are now available.

Oxidation

Mineral oil, being made up of hydrocarbons, has to a more or less extent an affinity for oxygen, especially when it is agitated and churned with a mixture of air in a circulating system and in the gear cases. The rate of oxidation of oils varies with the source from which it comes, certain fields producing oils which possess the tendency toward oxidation in a more pronounced manner than oils coming from other fields. Oxidation should be kept at a minimum in specifying a circulating oil.

Demulsibility

Next to proper viscosity, the principal requirement of a circulation oil, especially where water is liable to get into the system, is good demulsibility properties. The popular saying that oil and water do not mix is not strictly true, unless an oil having a high demulsibility, such as a highly refined turbine oil, is referred to. By the term demulsibility is meant the relative rate at which a violently agitated mixture of oil and water separates upon standing under prescribed conditions, the water forming a layer at the bottom of the container and the oil collecting at the top.

Sludging

Sludging is another undesirable property in a circulation oil. It is the tendency of an oil to develop precipitated deposits other than metallic particles and mill dirt. Sludge may cause trouble by clogging the oil lines to the bearings and closing up some of the sprays at the gears. After considerable use, even an oil of a high demulsibility may develop some sludges which will be precipitated at the bottom of the return tank. These sludges should be cleaned out periodically, as the presence of a small amount accelerates the formation of sludges. Oils of low demulsibility and having a tendency toward oxidation are particularly bad in the respect of sludge formations, and where such lubricants must be used, the deposits accumulated at the bottom of the return tank should be removed at frequent intervals, say every three months. The best way to do this is to pump all oil out of the tank while the mill is not in operation over the week-end, scoop out all deposits and clean inside the tank thoroughly. Merely pumping the sludges out of the tank without thorough cleaning is a job poorly done. It will be found that the sludges contain considerable amounts of steel particles and mill dirt held in close combination, which are of an abrasive character. The return tank should be so designed that periodic cleaning is facilitated. Continuous removal of any water that may have found its way into the oil will greatly reduce the tendency to sludging.

Foaming

Foaming, that is the formation of air bubbles in an oil, is largely a mechanical condition, although oils that are readily emulsifiable with water will produce foaming quicker than those of a high demulsibility test. Some of the causes of foaming are (1) too high a level of oil in the gear cases causing excessive churning; (2) too high a drop in the return lines above the surface of the oil in the drain tank; (3) leaks in the oil suction line at the pump. Where a considerable amount of foam has been collected on top of the oil in the return tank, the gentle agitation of the foam by blowing compressed air over it, has been found helpful. If a lubricant which has a natural tendency toward foaming is used, no apprehension need be felt if a foam of two or three inches thick is present at the surface of the oil in the tank. If the level of the oil in the gear cases is correct,

that is just sufficient to dip about ¼ of the tooth depth, and if other mechanical conditions are correct, the breaking up of the foam on standing will be equal to the formation of foam from the return lines, until a stable condition is established.

Film Strength

Film strength is what really counts in lubrication of machinery. The lubricating film separates the surfaces rubbing against each other, without ever touching in perfect lubrication. In general, the pressure which an oil film will withstand without breaking depends on the viscosity of the oil, light oil being used where the pressures are low and very viscous oils where enormous pressures are involved. Another characteristic of oils which affects film strength is what is known as oiliness. It is the affinity which the oil has for adhering to the metallic surface, penetrating into the microscopic pores of the metal, and resisting being wiped off. In other words, an elastic condition is created whereby the oil absorbed by the metal is exuded to the surface, so that a lubricating film, however thin, is in existence on the surface under the most adverse conditions.

Extreme Pressure Lubricants

Simultaneously with the development of new alloys for machinery building which surpass in strength ordinary carbon steels, the petroleum industry has developed extreme pressure lubricants, some of which are said to have a film strength estimated to be as high as seven times stronger than the lubricating film of straight mineral oils.

Extra film strength is imparted to oils by the addition of certain compounds. What is gained thus in increased film strength is usually at the expense of some other properties of the oil. When mechanical design and operating pressures are such that the use of an extreme pressure lubricant is advisable or imperative, the limitations of the extreme pressure lubricant should be recognized, and precautions should be taken accordingly.

The design and construction of the circulating oiling system should be so that the possibility of water entering into the system is reduced to a minimum. The quantity of lubricant in the system should be somewhat greater than if an ordinary oil were used, in order to make the interval between circulation cycles greater, so that the mass of the lubricant is not subjected to excessive agitation by permitting the oil in the return tank to rest for a longer period.

Flow of Oils in Pipes

Since we are primarily concerned with the flow of oils through pipes in a circulating oiling system, some of the factors governing the rate of flow of such fluids should be known and understood analytically.

In general, the rate of flow and the behavior of the stream of a liquid in pipes and channels is affected by the following factors: (1) the nature of the fluid, or its internal characteristics; (2) the external characteristics of pipes; (3) the nature of the flow—whether steady, pulsating or turbulent; and (4) the temperature at which circulation is carried on.

Gravity

Specific gravity is a factor in the calculation of the power necessary to pump or raise the oil to the required pressure head. Mineral lubrication oils range in specific gravity between .85 and .95 with an average of about .86. The higher the specific gravity, the more power will be required to pump the oil. The significance of gravity, as a general remark, has been overstressed on steel mill appplications, where we are accustomed to specify oversize motors wherever possible, especially in the lower ranges under 50 H.P.

Effects of Viscosity on Flow

As stated above, viscosity is identical with the friction of the molecules of the oil which retards the flow. The higher the viscosity, that is, the more sluggish the oil is, the more pumping power will be required to handle it, and the slower will be the rate of flow through the sloping return lines to the re-

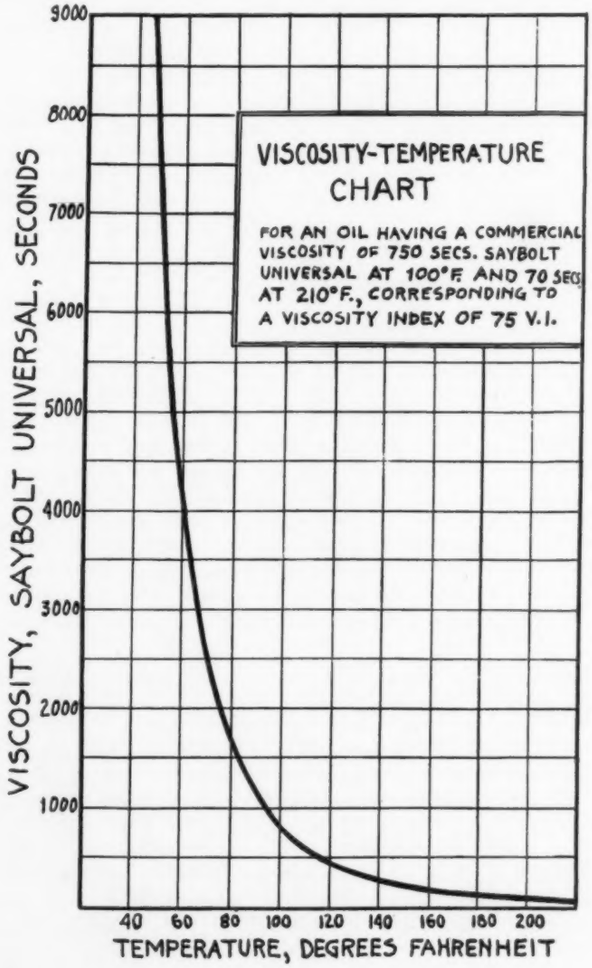

FIG. 1.

ceiving tank of the system. For power calculations, the figure for viscosity expressed in absolute terms, together with the density of the oil, should be used in the flow formula. The formulae given in text books on hydraulics cannot be applied to the pumping of viscous fluids like oil, because the entire science of hydraulics is built around the behaviour of water, and this is one case where the science of water does not mix with the science of oils without extensive modification.

Effect of Temperature on Flow

The temperature at which circulation is carried on is of utmost importance, as it ties in with viscosity in an abnormal manner. Fig. 1 shows the temperature-viscosity relation of a typical circulation oil of a heavy body. Note how steep the curve gets to be at the lower temperature range and how it flattens out at the higher temperatures. On Monday mornings mill temperatures may be down to zero, and circulation is impossible unless the entire piping system was heated during the time the mill was down.

Since the actual viscosity of the oil at the operating temperature is the index of the strength of the lubricating oil, the question is often raised whether or not it is wise to use a high viscosity oil and heat it to the point where it may be readily handled in the system. The answer is that an oil of the correct viscosity should be chosen that can be handled in the system without heating during normal operation, but steam coils should be provided in all return lines for emergency use during cold weather.

High Viscosity Index Oils

During the past year or two the petroleum industry has perfected by special treatment a type of oil which is characterized by a much flatter viscosity-temperature curve. Such oils are designated as having a High Viscosity Index, or in abbreviated form as having a high V.I. The advantage of such oils is obvious during year-around use—during the summer months the viscosity is maintained in spite of warm weather, thus affording adequate protection to gears and bearings, while during winter months the viscosity is not raised in a manner as pronounced as to cause an undue increase in power load on the motors, engines, or other prime movers. In other words, during summer weather actually greater protection is obtained while during the winter months savings are effected in the bill for power, if high V.I. oils are used.

External Effects

Among the external factors which affect the rate of flow of oil in pipes the following obvious items may be mentioned: (1) the slope of the pipes or the pressure head; (2) the size of the pipe, more resistance being offered to flow in longer than in shorter length and less in pipes having larger diameters; (3) the surface roughness inside the pipe, smooth surfaces in general conducting the fluid with less resistance than rough surfaces, although the roughness effect is not very pronounced in the flow of viscous fluids like oil; and (4) obstructions in the form of sharp bends, pipe fittings, and valves which impede the flow.

Nature of Flow in Pipes

The nature of the flow in pipes is of considerable practical interest. Only continuous flow, such as exists in circulating oiling systems, will be considered Depending on the viscosity and the diameter of the pipe, every fluid has a critical velocity, below which the flow is steady or in stream-line fashion, and above which the flow becomes turbulent due to the formation of eddy currents. Since in circulating oiling systems there is decided tendency to provide pipes of liberal diameter, we shall assume that the nature of the flow is below the critical value, or in stream-line, steady fashion.

In pipes conducting fluids like oil the actual flow may be visualized as movement of concentric layers sliding over each other with the fluid at the center of the pipe having the greatest velocity, while the layer wetting the inside surface of the pipe remains stationary as if stuck to the more or less rough surface. The average velocity as determined by the discharge through the pipe, is equal to ½ of the maximum velocity at the center.

Other factors being constant, the rate of flow, expressed as velocity in feet per minute, varies directly as the cross-section of the pipe and inversely as the "wetted perimeter," which is the circumference inside the pipe. It is obvious that the ratio of the cross section to the circumference becomes greater as the diameter of the pipe is increased, resulting in a higher velocity at a given pressure or slope. This, however, applies only to pipes that are always full with the fluid.

Concentric flow does not apply to the drain lines from the bearings or gear cases to the return tank, because the sloping lines are not necessarily full. Oil return lines should be regarded as open channels approximating a semi-circular cross section, in which the oil flows in arc-shaped or segmentary layers. The maximum flow is at the mid-point of the horizontal oil surface while the layer of an oil "wetting" or sticking to the bottom surface of the pipe is stationary.

The flow in open channels, or in partially filled pipes, depending on gravity drainage, is also a direct function of the cross-sectional area of the fluid divided by the "wetted perimeter." From a study of the ratio of the area of a circular segment to the length of the arc of the segment, we come to the conclusion that the flow will be a maximum when the pipe is only half full. Any depth above or below the height of the radius of the pipe results in lowered velocity.

In practice it is not possible to so design the drain lines that they will be only half full at all times. The principal consideration is not to flood the drain lines too full and thus develop a resistance which will impede free flow, causing the oil to build up to a higher level inside the gear cases or to leak out past the bearing clearances. The safe remedy is therefore to make the drain lines as large as consistently possible.

J. H. G. McCONECHY

The Generation of Power In Industry By Diesel Engines Using Heavy Fuel Oils

K. E. DeROSAY

By J. H. G. McCONECHY
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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September, 18, 19 and 20, 1934.

In 1897 after several years of experimental work Dr. Diesel completed his first successful commercial engine. Since that date there has been a gradual development, resulting from improved methods in manufacturing, discovery of higher grades of materials, scientific design and a deeper knowledge of the fundamental principles of injection and combustion of fuel oil. Thermal and mechanical efficiencies have increased to such a degree that at the present state of development a higher efficiency cannot be reached by any other process for converting heat into useful work.

In general the Diesel engine develops its power directly from liquid fuel injected into a cylinder without any previous process. The oil being delivered at a pressure of 3000# to 10,000# per square inch to an injection valve, which injects a finely atomized spray into a confined volume of air, previously heated to the ignition temperature by the compression of a rising piston.

In the earlier states of development the Diesel engine was of the four cycle type with high pressure air injection. Further development produced the two cycle type, also with high pressure air injection, and the latest phase of this development introduced airless injection for both the two cycle and four cycle engine. The most outstanding development in the Diesel engine engineering field was the introduction of the opposed piston engine and the double acting engine.

The smaller sizes of engines are of the trunk piston type, and the larger sizes, either for stationary or marine use, are manufactured with crossheads. Opposed piston engines, which have proved so successful in marine propulsion, are fitted with long piston skirts or trunks on both the upper and lower pistons in addition to crossheads and guides.

The modern engine does not follow the fundamentals of the Diesel cycle. Engines developing a peaked card, where the maximum initial pressure is in excess of the compression pressure, are usually associated with better fuel consumption rates. Higher peak pressures produce heavier loads on the piston pins, crankshaft pins and bearings, higher fuel oil injection pressures and increased liner wear, due to higher pressures behind the piston rings.

In conjunction with fuel injection, the shape of the combustion chamber is of vital importance; a point generally admitted in theory, but seldom realized in practice. A high grade of fuel oil is generally recommended for continuous and efficient operation of a Diesel engine; considerable study and research has been expended on the application of a grade of fuel which forms more or less a by-product of the oil companies.

The Diesel industry and the petroleum industry are mutually interested in the problem of Diesel fuels, and Diesel fuel specifications and methods of testing are being studied.

The economics of oil refining make it desirable that Diesel fuels be not restricted to the refined distillate class since these materials are the refiner's principal source of cracking stocks for gasoline manufacture. Cracking operations are probably going to increase in the future and it is desirable that the Diesel does not compete with the gasoline market for adequate fuel supplies.

Diesel manufacturers are realizing this condition and are directing their energies to designing Diesels that can satisfactorily burn cheaper grades of fuel oil of which adequate quantities are produced more or less as by-product materials in gasoline manufacture.

Numerous Diesel installations are now operating on these residual lower cost fuels at the present time without difficulty. Their service records compare most favorably with other prime movers and the lower cost of fuel oil further emphasizes the advantages of Diesel economy.

For generating electric power, providing the main units in marine propulsion, driving pumps or driving widely separated special machinery, either stationary or mobile, the Diesel engine is the ideal prime mover. When not required during idle periods the Diesel engine operating costs are at a minimum, as the load develops the engine can be started up immediately from the cold condition and applied to the load. This particular feature makes the Diesel en-

gine a valuable unit in the electric power transmission system in the capacity of carrying peak loads in conjunction with purchased power to eliminate demand charges. When used for generating power the output of each unit is proportioned to operate either singly or in multiple, according to load requirements, by manual or automatic control. The outstanding Diesel engine power plants of large capacities are located at City of Vernon, California; Shanghai, China; New South Wales, Australia, and Copenhagen, Denmark, ranging from 22,000 B.H.P. to 50,000 B.H.P.

Power units for rail traction are being developed in units up to 1000 B.H.P. at about 750 R.P.M. The advantages of the Diesel engine over steam for railroad systems are manifold. There is a substantial reduction in the cost of fuel, with a corresponding reduction in the cost of maintenance, the availability of the Diesel engine is greater, water is only required in small quantities, and refueling can be done not only more expeditiously but at longer intervals. In the cases of industries occupying large acreage where it is essential to do much transportation between different buildings, the use of Diesel engined shunting locomotives represents a very considerable economy, at the same time always being available for service without stand-by service during idle periods.

Although the Diesel engine offers the most efficient means of converting heat into useful work, there still remains approximately two-thirds of the total heat content of the fuel that is wasted through the jacket water and exhaust gases. By the use of waste heat boilers it is possible to recover much heat from the exhaust gases which would otherwise be dissipated into the atmosphere. The temperature of the exhaust varies from 300°F. to 700°F. with each type of engine, and boiler units can be obtained to produce hot water or steam at 15#, 50# or 100# working pressure with feed water temperatures of 60°F. to 160°F. Where the supply of water is abundant the water discharged from the engine cooling system can be used to advantage as boiler feed water.

The slow speed engine can be safely guaranteed for a period of over twenty years. The fuel consumption and repairs at the end of this period are about equal to the first year of installation. The actual life of the high speed engines cannot yet be determined, as engines of this type have only been in service for a few years. It would therefore seem safe to assume 5% for depreciation on both types of engines. Where engines are installed in existing power plants the present engine room staff can easily operate the additional units. In the case of all Diesel driven unit stations the operating expenses depend entirely upon whether the plant is operating on a 24 hour or a work day basis.

The maximum rates per annum for fixed charges on the overall investment may be taken as follows:

Cost of Money	7%
Taxes and Insurance	2%
Depreciation	3.02%

Oxy-Acetylene Cutting In Welding and Metal Working

By W. S. WALKER,
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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

Some of the first applications of the oxy-acetylene process of welding and cutting, dating back thirty years, occurred in the steel mill and foundry. Ferrous metals were the first ones welded; later, methods for welding practically all of the non-ferrous metals have been perfected. A recent cutting development of importance is flame machining, a method for removing surface stock from steel.

W. S. WALKER

A notable, recent development in steel welding utilizes a carburizing oxy-acetylene flame and a new welding technique. In welding pipe joints by this method, production of welds per man per day has been tripled, and quadrupled in many instances. Besides piping, this method has been applied successfully in plate and tank work, and in welding tubular aircraft joints.

Bronze-welding, regularly employed in repairing cast iron, steel and malleable iron machine parts, has grown greatly in popularity by the perfection of bronze welding rods giving higher strengths, greater

hardness and easier application. Bronze-welding is used extensively in fabricating equipment and piping of galvanized iron, and is used in joining copper, nickel and many of their alloys. Brass pipe of large diameter has been successfully bronze-welded. Reciprocating machine parts are reclaimed by building up worn surfaces with bronze-welding and machining to size.

Certain brasses and bronzes formerly thought to be unweldable are now successfully oxy-acetylene welded. Suitable methods for welding chrome and chrome-nickel cororsion resisting irons and steels have also been perfected.

Applications of hard-facing parts subject to wear have been increasing rapidly with immense savings to industry. Many uses for hard-facing in the steel industry are noted. Hard-facing alloys now available include: diamond substitutes; a non-ferrous cobalt-chrominum-tungsten alloy; less wear resistant alloys containing some iron; and alloy steel materials.

Precision machine cutting with the oxy-acetylene blowpipe has been demonstrated as a commercial possibility. For many reasons an entirely new industry has grown up around the fabrication of machine frames and bases from rolled steel cut to shape by machine flame cutting.

Flame machining, a method for removing surface stock from steel by oxy-acetylene cutting, was first employed in deseaming steel billets and is now being applied to such operations as planing, milling, turning, drilling and boring. Surface metal is cut away at a rate greatly exceeding that for regular machine tools. Many applications of importance to the metal working industry are in view.

The Progress of Centralized Lubrication In The Steel Industry

By A. J. JENNINGS
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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

Proper lubrication is of vital importance to the Steel Industry and no industry offers a greater opportunity for lower costs and higher operating efficiency by means of better lubrication.

Good lubrication not alone demands the use of the correct grade of lubricant, but also that this lubricant be properly applied by a dependable method and at regular intervals.

Intermittent lubrication by hand generally results in a feast or a famine for all bearings and—some may be missed entirely. Wasted lubricants—increased friction—high power losses—frequent shut-downs for repairs and lost production always follow.

The use of a modern centralized system of lubrication combined with the correct grade of lubricant will — avoid waste of lubricants — reduce friction — lower consumption of power—increase life of bearings—reduce repairs—increase production and provide complete safety.

This paper will include many illustrations and record the practical results of the use of centralized lubricating systems on practically all types of rolling mill equipment. A complete flow sheet has been prepared for this purpose, listing the items of equipment in the different types of mills to which centralized lubrication has been applied and the subject will be treated progressively, starting with the blooming mill and concluding with the finished product.

In addition the paper will also illustrate and describe all of the leading devices offered for this service in an attempt to present a comprehensive review of the progress of centralized lubrication in the Steel Industry. Showing where the equipment is being used, what has been accomplished by its use, and where suitable equipment for this purpose may be purchased.

A. J. JENNINGS

Servicing of Steam, Turbine, Diesel and Transformer Oils

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

The study of various electrical insulating oils shows definitely that their deterioration is caused by contamination which consists of free water, solids, and various types of sludge which are mostly soluble in such types of mineral hydrocarbons. Such sludges are caused to form due to the presence of oxygen in the oil, and are of three principle types: the soap, asphaltic, and carbon types. Analysis of such sludges show an abundance of oxygen.

Tests have proven that hydrocarbon mineral oils which have been thoroughly degasified and dehydrated have extraordinary high dielectric values and resist oxidation to a marked degree. This is especially true when such oils, after being thoroughly degasified, are maintained in sealed systems under positive pressure.

Suitable apparatus for removing such contaminants has been perfected and marketed, and definite operating data has been secured which shows marked improvement in operation both from a dielectric standpoint and a definite reduction in temperature of transformers.

Lubricating oils for turbines are usually contaminated by dust, rust, water accumulating from steam leaks, and various sludges. Acids are formed in heated turbine oil by a combination of oxygen from the air and act on the oil as extremely strong emulsifying agents. Sludges formed in turbine oils are also due to a reaction between oxygen and oil and act to form more sludges with increased temperature, and in the presence of catalyzers, such as copper and brass tubing in the oiling system.

Diesel engine oils are also contaminated by oxygen, and large quantities of carbon residue and water condenses on the interior of the crankcase. Such oils can now be reclaimed economically, and the quality brought up to equal that of the original oil, and in some cases even better.

This, of course, is all predicated on the fact that only the best grade of oils be used initially, such oils can be reclaimed any number of times and at a cost per gallon that is very economical.

The treatment for reclaiming and reconditioning such oils consists of removing all the light volatiles by means of a low temperature vacuum treatment, and then removing the polymerized compounds, resins, tars, waxes, and acids, by a simple adsorption process which consists of intimately contacting the oil with Fuller's earth for a definite time and at a definite temperature, and then thoroughly filtering out the earth with its adsorbed impurities. This operation, of course, removes the soluble contaminants as well.

When high grade oils are properly treated to remove the contaminates, it has been found that their lubricating value is greatly enhanced. This has been confirmed by the U. S. Bureau of Standards. Many practical tests have been run at various air ports on reclaimed oil for aircraft motors with satisfactory results.

R. P. DUNMIRE

Tests on a steam turbine extending over a period of four years show that there is practically no increase in acidity of oil, and that the steam emulsion value of the oil remains practically constant.

When the oil is continuously vacuum treated, diesel as well as turbine oil can be maintained in a position comparable to that of new oil, and color can be restored to its original number economically. This is also true of automotive crankcase oil where control is based on using a good oil initially and of the same base.

It is fundamentally true that the economical reclamation of a lubricating or insulating oil depends largely on the quality of the original oil, as well as the refining process and equipment. The better the grade of oil initially, the greater the percentage of recovery with a corresponding decrease in costs of recovery and total lubricating costs can be expected.

Oils that have been poorly refined originally are unstable in virtually all of their characteristics, consequently, are expensive lubricants.

Special Electrical Drives For Steel Cleaning and Processing Machines

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

For over thirty years the electrical engineers in the steel mills, in co-operation with the engineers of the electrical manufacturing companies, have successfully worked out the many problems involved in the main roll drive and the directly associated auxiliaries. With the major problems successfully solved, attention has been directed to the problems connected with the secondary processes in the manufacture of steel products. Particularly interesting examples are the individual drive of runout tables, the sectionalized control of frequency motor generator sets, and the reversing motors used in connection with the feeder and catcher tables. Several papers have been presented before the Association, describing in detail the electrical features of such drives.

It is a privilege and a duty for the manufacturers of electric motors and controls to match the ingenuity of the steel mill engineer by furnishing the proper type of electrical apparatus to successfully drive the ingenious machines and supply power for the special drives which the steel mill engineer has conceived. Steel products play such a large part in the industrial life of today that the number of special electrical drives in connection with the manufacture of steel and steel products is almost legion. This paper is devoted to machines and drives particularly relating to steel cleaning and processing. Only a small part of this field is covered in the selection of a few drives with which the authors are particularly familiar and with some of which drives the general membership of the Association may not be acquainted. Each installation could well be the subject of a complete paper. The drives are selected with the particular purpose of illustrating how the proper selection of motors, with suitable characteristics, best serves the requirements of a particular drive. The requirements of a drive are analyzed particularly from the viewpoint of the motor manufacturer, and while the control is referred to no attempt is made to completely cover the control problems.

In selecting suitable motors for an unusual type of drive the following must be carefully considered:

1. The work to be accomplished.
2. Space requirements.
3. The most suitable speed.
4. Method of mounting.
5. Type of enclosure.
6. Electrical characteristics.
7. Torque demand.
8. Dissipation of heat.
9. Protection against mechanical failure.

While the electrical performance, with relation to efficiency and power factor, should not be overlooked usually on a secondary drive the advantages to be gained of continuous operation without delay far overbalances any question of a slight increase in efficiency and power factor. The same is true of the cost of electrical equipment. Compared with the cost of electrical equipment for the main mill the cost of the electrical equipment for the secondary drive is relatively so small that improved results in production and continuity of service justify any reasonable increase in cost.

A. M. MacCUTCHEON

The following drives will be described in some detail from the standpoint of the problems encountered, the motors supplied, the control used, and the results secured. Where permission has been secured the name of the steel company operating the machine or drive is given.

STEEL CLEANING

Continuous Pickling of Sheets.

Wheeling Steel Corporation, Steubenville Plant.

The Billeteer

Manufactured by the Bonnot Company, Canton, Ohio. Installed at Youngstown Sheet & Tube, as well as several other steel companies.

Used for rapid and efficient removal of flaws and seams.

The Airless Wheelabrator

Manufactured by American Foundry Equipment Company, Mishawaka, Indiana.

STEEL PROCESSING

Automatic Tinning Machine

Installed at the Inland Steel Company.

Continuous Galvanizing Drive.

To be installed in a prominent southern steel company.

Drop Hammers.

Budd-McKay Sheet Processing Machine.

Manufactured by the McKay Machine Company, Youngstown, Ohio.

Installed in a Cleveland Plant, Cleveland, Ohio.

WATER-COOLED MOTORS

In connection with several of the installations of the Budd-McKay Sheet Processing Machine limited space and increased rapidity of operation require the use of a water-cooled motor. In connection with special processes in the steel mills it would appear that a water-cooled motor may be very useful. Several motors have been developed of this type which give unusual results in providing a motor small in size and yet cool in operation. Such a type of motor is particularly advantageous where the surrounding atmosphere is of a high temperature. The water cooled stator acts as a protection against the high outside temperature as well as a means of efficiently and economically removing the heat generated in the motor itself. Such a motor will be described in considerable detail with illustrations. The most remarkable fact about a water-cooled motor is the small amount of water necessary to remove the heat resulting from the losses within the motor, and the consequent small cost of the water involved. The stators are so designed that if a release valve is open all water will drain from the inside of the motor, exactly as the water is drained from the cooling chambers of an automobile engine.

Super-Imposed Steam Turbine-Generator Plants For The Steel Mill

By A. G. DARLING
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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

A review of industrial practice in power plant design indicates conservatism as one of its inherent characteristics. When reliability has been proved, industry has welcomed improvements to reduce power and steam costs. The steel industry uses a large amount of moderate pressure steam for other purposes than electrical power, which condition results in a favorable opportunity to realize the energy available between high and existing plant steam pressures by the use of non-condensing steam turbine-generators. Developments in steam plant design over the past ten years coupled with turbines suitable to the expanding energy range, have resulted in the realization of high efficiencies. Enough of these plants have been in operation for a sufficient length of time to permit an accurate estimate of their reliability. Some examples of present-day plant conditions show how the imposition of a high pressure boiler and turbine-generator will affect the fuel and water-treating costs, or the plant electrical output. The improvements indicated lead to the conclusion that, for similar cases, the possibilities are sufficiently attractive to suggest a close investigation of the super-imposed plant. Resort may be made to the use of evaporators in order to secure the necessary purity of boiler feed water at some reduction in operating savings but, from a technical standpoint, chemical treatment with elimination of precipitated solids appears to be a feasible solution to this vital problem. With less expensive electrical power, the applications of mechanical power by steam will be less attractive in many cases to the extent that some may show greater economy if changed to electrical drive. Electrical heat treating, welding and other uses continue to add to the value of metal products and produce a higher electrical consumption per unit of product, so reducing the generating reserves and tending toward the expansion of the electrical power plants. The need for added, less expensive, electrical power is increased by these means. The super-imposed steam turbine-generator plan offers the possibility of an economical means to meet these demands.

A. G. DARLING

Electric Discharge Tubes For Resistance Welding

By DR. J. SLEPIAN
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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

DR. J. SLEPIAN

In modern resistance seam and spot welding practice a rapid succession of carefully measured and controlled current pulses of high intensity and short duration is used. The great rapidity with which these pulses of current must be switched on and off, makes it impractical to produce them by the opening and closing of contacts of a mechanical switch. Electric discharge tubes have great advantages here when used as switching elements.

The electric discharge tubes to be considered here are not of the high vacuum type such as are used in radio, but contain a gas or vapor, usually mercury vapor at low pressures. To understand how such discharge tubes can be used as switching elements, we must examine the essential parts of the discharge and see what are the conditions for the existence of these parts so that existence of the discharge as a whole may be controlled.

The current is carried between the electrodes almost entirely by electrons leaving the negative electrode and passing to the positive electrode. If the current is to flow freely, electrons must leave the cathode or negative electrode freely and in large numbers. That is, the cathode must be electron emissive. In addition, the electric field which the electrons in transit from cathode to positive electrode or anode would produce because of the charge they carry, and which would exert a repelling or retarding effect on the electrons being emitted from the cathode, must be neutralized. This is accomplished in the gas filled tubes by the positively charged ions arising from the ionization of the gas by the electrons accelerated in electric field in the space between cathode and anode, called the positive column.

Two types of electron emitting cathodes are in use. The thermionic cathode uses an electrode, usually a filament, which is maintained by a separate heating current at a temperature high enough for electron emission. The other type which we may call the cathode spot type is exemplified by the wandering brilliant spot on the mercury pool of a mercury arc tube. Such a cathode spot, when once started, is self-maintaining as long as current flow is continued, but requires special means for restarting if the current is interrupted. A cathode spot may be started by breaking contact of the cathode with an auxiliary electrode but such initiation of the arc is not suitable for rapid control of the discharge. A new method of starting a cathode spot, almost entirely free from inertia, has recently been discovered by Ludwig and Slepian, and applied in the Ignitron has opened up new fields of application of electric discharge tubes.

Where the thermionic cathode is used, the control of the starting of the discharge is effected by governing the conditions for the formation of a positive column by means of electric potentials applied to a grid interposed between the cathode and anode. The cathode remains continually electron-emissive. In the Ignitron, however, the cathode becomes electron-emissive only when a cathode spot is formed, and such cathode spots are formed easily and quickly in any desired rapid succession by small current pulses to the Igniter electrode. Thus the Ignitron, because of its rugged indestructible high current capacity cathode, and the unobstructed path which it offers for current flow from cathode to anode is eminently suitable for applications of electric discharge tubes as switching elements in heavy current power circuits.

Recent Developments In The Welding of Aluminum Alloys

D. I. BOHN

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

Although many of the physical properties of aluminum alloys are similar to those of steel, these alloys differ so greatly in their thermal and electrical properties that the equipment and methods used for welding them are greatly different than with steel.

All of the high strength, wrought aluminum alloys obtain their physical properties from heat treatment. Any weld in these alloys removes some of these properties over the zone which has been heated above certain temperatures. The extent of this affected area varies considerably with the various methods employed, a torch weld providing a larger affected area than an arc weld, while with resistance welds the affected area is practically entirely confined to the zone in which fusion has taken place.

Torch welding has been in common use with many of these alloys for a number of years and will not be discussed.

Metallic arc welding, although relatively recent, is growing in favor for a great many applications, it providing a narrower annealed zone than is obtainable with torch welding.

Manual carbon arc welding is being used to some extent and such excellent results have been obtained with the automatic carbon arc that it is expected that this method will substantially increase in favor for certain types of work, such as large tanks.

Spot and seam welding have reached the stage where with proper equipment, results comparable to those obtained with steel may be expected. The equipment to spot and seam weld these alloys, particularly some of the high strength, heat treated alloys, such as duralumin, demand a precision of electrical control much greater than is customarily employed with steel. Electronic equipment is available which admirably fulfills this requirement.

Much higher welding amperages are required for resistance welding of aluminum than for most other materials so that the electrical design of the equipment must be such as to provide this desired high current.

The designer contemplating the use of welded construction with the aluminum alloys must be familiar with the various methods of welding and his design must be predicated on the use of these methods in such a way that the high strength properties of the alloys used are maintained in the completed structure.

Individual Motor Drives

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Abstract of paper to be presented at the A. I. & S. E. E. Annual Convention to be held in Cleveland, Ohio, September 18, 19 and 20, 1934.

With the advent of continuous mills the problems of operation and maintenance incident to the means of conveying and disposing of the finished material, have indicated the desirability of individual motor drive.

The operation of the earlier continuous mills with individual motor drives on runout tables, together with the further development in these mills as they

have been increased in operating speeds, today dictate the practical necessity of using individual motor drives for these applications. It is repeatedly demonstrated that due to some unforeseen development in operation or practice, the flexibility provided through such drives is in itself alone sufficient justification for their use.

Rather than dealing historically with a complete mill installation, it is the intention in this paper to consider the case of the finishing end of a 72" hot strip mill as a type case. The principal considerations entering into the selection of motors and motor-alternator sets for the operation of runout table and coilers for such a mill will be discussed.

The speed range, mill power supply, operating conditions, time of acceleration and deceleration, and plan of operations must all be introduced. Under different conditions any one of these items is likely to become the final determining factor in the selection of motor equipment.

With the ever-increasing tendency to step up operating speeds, the problem of stopping the rollers or coiler becomes such a major item that ordinary means are not adequate. The use of dynamic braking through direct current as applied to the individual motors on runout tables and coilers, all as covered by patents, will be dealt with in this connection. The fact is brought out that such braking permits of adjustment in stopping time over a wide range, stopping in shorter times, with far less loss, and with smaller motors than a-c. plugging would make possible.

The rather unusual problems incident to successful operation of coilers with individual motors on each roll will be outlined. The considerations which result in the use of motor-alternator sets for coiler drive which are larger in proportion to connected horsepower than for runout tables will be described.

The more common means of control employed for all these purposes and as dictated by the plan of mill operations, will be described including the time delay sequence starting.

In conclusion the various motor types will be discussed, bringing out the particular place of the open, fan-cooled, straight fully-enclosed and pipe ventilated types in mill installation. The economic and other factors leading to the possible use of gear-motors for this purpose will be discussed.

SPECIAL NOTE

IRON & STEEL EXPOSITION

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ON THE FLOOR OF THE

IRON & STEEL EXPOSITION

In these following pages, Engineers of the Steel Industry and Manufacturers servicing the Industry express what progress has been made in the various fields of Steel Mill Engineering.

The Thirteen Month Year In Industry

By MARTIN J. CONWAY
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MARTIN J. CONWAY

Heretofore astronomers were consulted when calendar reform was suggested, because the changes with which they dealt had to do with the adjusting of the calendar to the length of the Solar Year. With the Gregorian reform of 1582 the task of astronomers was completed. The reforms now proposed do not interfere with astronomical equations for the Solar Year, but simply with the arrangement and composition of the calendar's weeks and months within the year, and as easy to apply as Daylight Saving Time.

In choosing a plan of reform, practical experience is the test of worth. More than 400 large businesses in the United States and Canada have within recent years adopted private business calendars consisting of 13 equal "months" of four weeks.

The Lukens Steel Company was among the first to use the plan which has been in use at their plant since November 1, 1927. They adopted the thirteen period year as an aid in the comparison of operating and cost statistics, and it has become indispensable to the management and executives associated with this company.

This calendar is used in order to escape the disadvantages of the 31 and 30-day months and broken weeks of the present calendar for their accounting, statistical reports, and business management.

One plan advanced by M. N. Stiles[1] is that the calendar be divided by thirteen months of four weeks each. The names of the present months are retained. The additional month called "Sol" is placed in the middle of the year, between June and July, in order to disturb as little as possible the positions of the present months within the year.

Calendrically, December has 29 days, and the last week of that month has eight days. This eighth day is given the non-week-day name of "Year Day" to be dated December 29, and would be observed as a holiday. In leap years the last week of June has eight days with the last day given the name of "Leap Day" dated June 29, and would likewise be observed as a holiday.

Practically a 364-day business year is created for the most of our business activities. Each month then is an exact multiple of the week, and as near as nature will permit each month is a sub-multiple of the calendar year, and an exact sub-multiple of the 364-day business year. In terms of months, the quarters do not contain a whole number of months, but each quarter has exactly thirteen weeks. Each year would begin on Sunday. Each month would begin on Sunday, as would each quarter. Each day of the week in each month would fall perpetually on the same recurring dates. This arrangement is the nearest possible to a perfectly uniform, perpetual solar calendar that can be devised without abandoning the use of the seven-day week.

In business, the use of the month and the week as measures of performance and for comparative reports and statistics is immeasurably greater than that of quarters. Industry no longer waits for a quarter of a year to elapse before finding out where it stands. One need only review the financial pages of newspapers and trade magazines to find out that a multitude of statistics are now based on the week. These cannot be correlated with the month of the present calendar.

The fact is that in many businesses where weekly statistics of sales, production, etc., are essential to keep close track of performance and of current trends, and where monthly statistics are also essential for monthly financial statements, the splitting of weeks at the beginning and end of the month requires extra labor that would be eliminated if four weeks coincided with a month. This defect of the present calendar is one of the reasons why the use of the thirteen month business calendar is growing.

To give some examples why months with broken weeks are not comparable: The retail trade-chain stores, department stores, etc., do a large percentage of their business on Saturdays. Evening newspapers obtain the largest portion of their advertising on Fridays. Hotels get their best patronage on Wednesdays and Thursdays. An outstanding example of month to month comparisons of vital importance to our economic life is the monthly statistics of foreign trade and resulting changes in the trade balance, frequently distorted when there are five week-end sailing dates in one month compared with four in the previous month.

One objection generally cited against the four

[1] American Secretary of the International Fixed Calendar League, and delegate of the National Committee on Calendar Simplification for the United States to the first International Conference on Calendar Reform at Geneva in 1931.

week month is that it would make a break in the continuity of statistics, but let us consider if this break would be as serious as is supposed. The present depression has shown that long time economic statistics are of no great comparative value. Too many underlying conditions have changed and are changing, too many bases upon which the statistics were made have changed to new levels to give long ago business or performance records an important practical value; but, the point that does not seem to be perceived is the fact that long ago statistics are rarely compared by months, they are compared by years. Who compares rolling records, furnace outputs, sales records, profit and loss of October, 1931, with October of 1921 or October, 1911, unless it is for curiosity. The view that far back is in years—not months. The important use of monthly comparisons lie almost wholly in their disclosure of the changes and trends from one year to the next and within the current year. It is from these data of the immediate past that decisions are made for the immediate future.

At least, to stay clear of various controversies, a thirteen period year can be used, starting the "working year" one day earlier each calendar year, with the thought that several generations must pass be-year.

New Equipment For The Steel Industry

By R. J. WEAN
President, The Wean Engineering Company, Inc., Warren, Ohio

R. J. WEAN

During the past few months five domestic sheet producers have installed additional "Combination System" rolling equipment. Foreign sheet makers are also adopting this method of rolling. An Australian steel producer is currently erecting continuous furnaces, rolling tables, and allied conveying apparatus. Perin Engineering Company is engaged in supervising the installation of "Combination System" equipment which will double The Tata Iron & Steel Company's mechanical rolling capacity.

Recent developments in centrifugal abrading machines may revolutionize steel cleaning practice. Abrasive cleaning employing compressed air is an old art, but the high cost of air and its attending disadvantages have prevented the general adoption of air blasting in the steel industry. These objections are not present in centrifugal abrading which uses a rotating wheel to obtain the essential cutting force. Billets, slabs, bars, pipe and strip are all being cleaned commercially by mechanical abrasion. The practice is sufficiently established to justify prediction that Wheelabrator cleaning will supplant pickling for many steel products where the only object is to clean the surface. For special surface requirements mechanical abrading offers unequaled preparation in coating sheets and strip. The quality of culvert stock and similar galvanized products can be materially improved through Wheelabrator preparation. In those processes where centrifugal abrading does not supplant pickling, it has wide possibilities as a supplementary operation in preparing sheet surfaces for accelerated acid attack. Reduced acid consumption, higher acid yield, and the corresponding reduction in hydrogen absorption are the major advantages of abrading prior to pickling.

Wheelabrator design lends itself to enclosed bombardment cabinets permitting healthful working conditions.

A successful sheet piler which stacks cut sheets up to 72" wide by 200" long at 300 feet a minute will interest wide strip producers. These pilers can be installed at any point in the producing process, but are particularly valuable following tandem finishing lines which include side trimmers, scrubbers, driers, and flying shear. The high operating speed of the piler increases the capacity of each processing line, thereby reducing the number of installations required for a given tonnage.

With the development of an uncoiling machine which eliminates coil break, the wide strip producer is now in position to accept barrel stock tonnages. By eliminating coil break, the uncoiling machine also prevents deep etching in fractured areas when used in conjunction with continuous pickling. This application assumes particular importance if the pickled material is intended for subsequent cold reduction to auto body gauges, because cold rolling does not smooth out the deeply etched surfaces where the scale fractured during uncoiling.

The Budd-McKay sheet processing machine, which eliminates stretcher strains, relieves auto body sheet producers of a major problem. These strains develop during the forming operation when the grain structure of the steel yields unevenly, producing in the strain area the affect of lines and designs intaglio. Strain lines cannot be concealed by enamel or paint, consequently their presence contributes to high rejections. In the past stretcher strain rejections could be reduced by cold rolling, then roller levelling, but these operations were not sufficiently severe to place the sheet in a plastic condition for any appreciable length of time; neither were they severe enough to eliminate stretcher strain in all sheets. Furthermore, cold reducing increased fracture hazard through cold hardening. The severe reverse bend imparted to the sheet during the processing operation produces in the product the essential plasticity which substantially eliminates stretcher strains. This working or kneading of steel sheets also retards age hardening. Several prominent auto body fabricators have installed processing machines during the past few months.

Illumination For Deseaming Purposes

By R. F. SANNER
Assistant Chief Maintenance Engineer, Carnegie Steel Company, Duquesne, Pa.

R. F. SANNER

Recent years have brought about many changes in the manufacture of steel. Formerly, steel was purchased merely as steel, with little or no attention given to specifications or purpose for which it was to be used. Steel producers, in collaboration with the purchasers, have studied the application of steel and now steel is produced and purchased according to rigid specifications. This change in requirements has made it necessary for the producer to utilize every means known to the industry to produce a product, every piece of which will meet the specifications.

One of the processes in the preparation of steel for rolling into the finished product is that of deseaming. In order to be certain that all the seams, laps and other surface defects are removed before the final rolling, very thorough inspection is required. The thoroughness of this inspection has gradually increased to a degree where the illumination requirements in a deseaming building or yard are on a par with those of a drafting room, or even more exacting. It is not uncommon for the deseaming and inspection departments to request lighting intensities of 20 foot candles for chisel deseaming and 30 foot candles for scarfing or torch deseaming.

The lighting intensity required for machine deseaming is the same as that required for chisel deseaming. The problem of providing this intensity is simple, because of the very much smaller area that requires illumination. Either the bloom or billet moves on the machine and the tool position is stationary, or vice versa, necessitating only several small lighting units of the proper design, mounted on the tool supporting head, to provide the required illumination.

The real lighting problem is encountered when it is proposed to provide adequate illumination in a large building which will house several hundred deseamers and inspectors working on extensive beds of blooms or billets. Seldom do plant executives realize the money expenditure required for illuminating an area for deseaming purposes.

For illustration, we may assume a building, for deseaming blooms and billets, whose dimensions are 90′x400′. We may further assume, that this building has several electric overhead traveling cranes, making it impossible to mount the lighting units less than 40 feet above the working plane. Conditions such as these are common in modern deseaming buildings. Without working through the detailed calculations, a building of the dimensions specified above would require 115—1000 watt lighting units for an intensity of 20 foot candles, and 175—1000 watt lighting units for an intensity of 30 foot candles.

An estimate of the expenditure required to make an installation equivalent to the above would be somewhat as follows:

Required Lighting Intensity—30 Foot Candles

175—High bay lighting units (with lamps)	$ 5,513.00	(list)
1—200 KVA transformer, 6600/220/110 volts	1,767.00	"
1—Transformer building erected	1,748.00	"

Disconnect switches and low tension breaker	780.00	"
Safety switches, insulators, conduit, etc.	895.00	"
Cable	1,000.00	"
Labor	2,100.00	"
Total	$13,803.00	

The estimate for a lighting intensity of 20 foot candles would be proportionately lower.

In addition to the above investment, the following yearly expenditures would be required:

Power at $.005 per K.W.H. (Lights burn 24 hours per day)	$ 7,560.00
Lamp replacements (assuming average life of lamps = 2000 hours)	2,800.00
Maintenance (material and labor)	500.00
Fixed charges (13% of original investment)	1,790.00
Total	$12,650.00

Assuming that the plant concerned was manufacturing steels of varied specifications which required widely varying amounts of time per ton for deseaming purposes, it would not be possible to deseam and inspect more than 25,000 tons of steel per month, or 180,000 tons per year. To translate the foregoing estimated figures to cost per ton, we find that adequate illumination in a building 90'x400' for inspection and torch deseaming purposes will cost approximately $.07 per ton of steel deseamed.

The above figures indicate that illumination in a steel plant has attained the proportions of nearly a major problem, and that it can no longer be looked upon as an incidental which can be passed over without any thought or consideration.

131 Years A Growing

By J. S. ERVIN
President, Mackintosh-Hemphill Co., Pittsburgh, Pa.

J. S. ERVIN

Mackintosh-Hemphill Co. always engaged in "history in the making," will shortly publish a book of facts showing "history they have made in their One Hundred and Thirty-one Years of Continuous Life. Among these is the fact that in 66 years, or since 1868 when our country began to roll products on an ambitious scale, they have produced a mill of one of the various types every thirty-four days. Another fact disclosed will be their trail blazing in having introduced to mill practice, every basic type of cast roll in actual service today.

Due to limited space here, reference is only possible to a few of their latest developments, which they are offering the iron and steel industry today.

They are now designing and building a reversing hot strip mill for rolling strip up to 12" wide, and down to 18 gauge. It will be the first of its kind, expressly designed and built for that service.

The mill will be arranged to roll long slabs back and forth for a number of passes. After the proper thickness is obtained, the strip will be diverted into coil furnaces located on both the entering and delivery sides of the mill. After the desired thickness is reached, the strip will bypass the furnace on the delivery side and enter a conventional 3-roll coiler, from which it will be taken by crane to the coil storage.

They are also designing and building a three-high sheet mill with automatic front and back tables. It will be the fastest of its kind yet built. The mill will be designed with balanced top and middle rolls, the top and bottom driven through the conventional type of pinion stand. Water bearings will be used on the top and bottom rolls, the middle roll will be equipped with roller bearing necks. Screwdown will be designed for quick acceleration to minimize the elapsed time for setting of the screws between passes.

Considerable interest and activity prevail on four-high hot and cold mills evidenced by the number of propositions going through their engineering department, all calling more than ever for greater efficiency of design and greater simplicity. Some radically new developments with patented features are under way towards better mill performance and improved product in texture, finish and greater widths of sheets and strips. It was in 1927 they had the honor of being the first to install a mill of this type.

Beside the conventional types of rolls of steel, chilled iron, alloy steel and alloy irons, they have recently developed to commercial success, several distinct types, featuring respectively properties not so prominent in standard rolls such as greater chill

depths, anti-slippage, non-firecracking, resistance to wear, or greater strength.

Among their complete range of steel, alloy steels, iron and alloy iron, is their duo texture metal Wearprooft MacHempIte—a patented product which has successfully changed versus to plus where strength and wear apply. Its zone surfacized area is 70 to 90 scleroscope with a non-brittle homodurus and homodensus structure, while its backbone is a strong shock-resisting anti-fatigue metal. Gears and pinions, track wheels, cams, housing nuts and screws suggest its unique field of usefulness.

The Johnston corrugated cinder pot (patent pending) which they manufacture, is gaining wider recognition as a great advance in design and construction for efficient service and longer life—anti-cracking—non-bulging, skull-free after dumping, returning clean, outlives conventional design three to five times. Made in all sizes for both blast furnace and open hearth service.

In rod and merchant mill service in the rolling of rounds and hexagons their patented thrust bearing is setting up new standards of performance. This simple and inexpensive method eliminates end floating and other difficulties affecting bearings that are transmitted to the product, and thus permits rolling to closer tolerances. On a 7/8" round before application of their bearing, the tolerance was 15000ths—after application—a maximum of 6000ths with most of the run 3000ths.

Their full line contact design for coupling box service is rapidly ousting the standard type. Distribution of load over the whole surface rather than just at the tip, readily reveals its merits. It is usually made of Wearprooft MacHempIte.

Combustion Control For Open Hearth Furnaces

By H. H. GORRIE
Combustion Engineer, Bailey Meter Company, Cleveland, Ohio

In open hearth furnace operation only the heat developed above the temperature of the bath is available for absorption. The higher the flame temperature, the greater the rate of heat transfer and therefore for best operation, it is essential to maintain as high a flame temperature as is consistent with furnace life.

The principal factors effecting the flame temperature, are the calorific value of the fuel, the sensible heat of fuel and air, the quantity of air supplied for combustion, the intimacy of mixture of fuel and air, and the quantity of air infiltration to the furnace.

Since the choice of fuel and the mixing of fuel and air are dependent upon plant operating conditions and furnace design, the problem of open hearth control then resolves itself into:

(1) Fuel-air ratio control, to maintain the proper quantity of air for combustion. Control of air for combustion also affects preheated air temperatures.

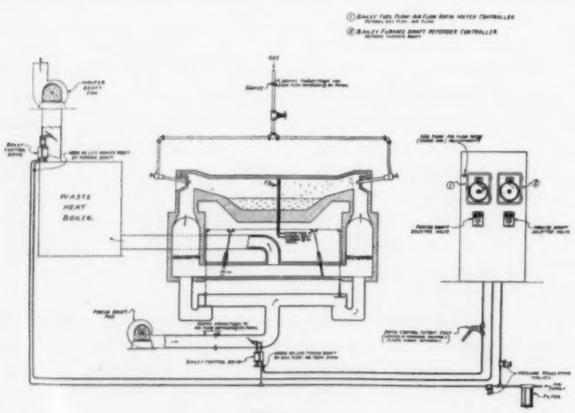
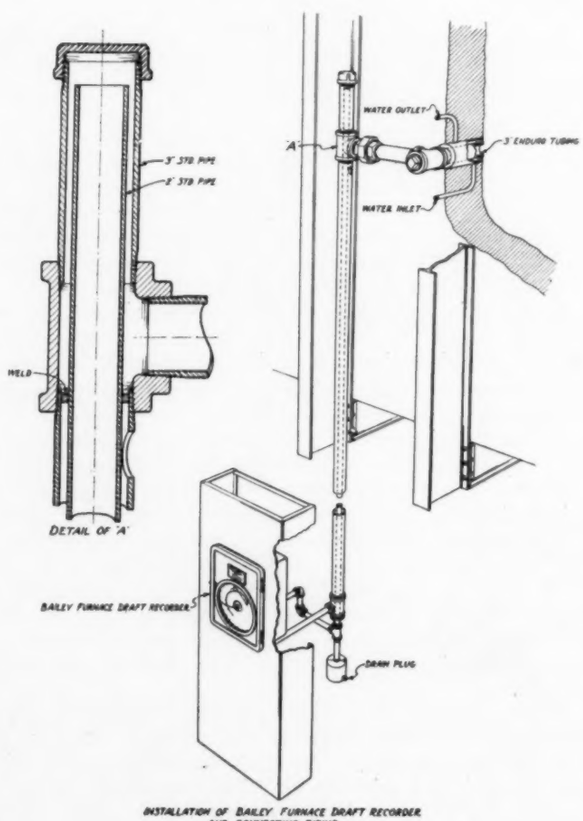


FIG. 1.



INSTALLATION OF BAILEY FURNACE DRAFT RECORDER AND CONNECTING PIPING

FIG. 2.

(2) Furnace draft control, to decrease furnace air infiltration to a minimum.

Two substantially independent control systems are required to accomplish these results.

A typical layout of our air operated fuel-air ratio and our furnace draft control equipment as applied to open hearth furnaces equipped with forced draft fans is shown by Fig. 1. The metering equipment consists of a gas meter, arranged to record the ratio of total fuel input (on a B.t.u. basis) to the total air flow, and a highly sensitive meter for recording the furnace draft.

The fuel-air ratio meter is arranged to operate an air pilot valve which establishes loading pressures proportional to fuel input and to deviations from the desired fuel—air ratio. This loading pressure determines the forced draft control drive and damper position. The fuel-air ratio may be manually adjusted to the desired setting.

The furnace draft meter similarily operates to position the induced draft control drive and damper proportional to variations in furnace draft.

Selector valves are provided to permit manual control of either induced or forced draft as desired.

A ratio control cut-out cock is provided at the reversing control post to permit the operator to interrupt the operation of the ratio control equipment during reversals.

This feature eliminates unnecessary furnace disturbances during reversals and insures purging the waste gases from the checkers before completing the reversing cycle.

In view of the necessity of measuring and controlling furnace draft with great precision, the method of making draft connections between the furnace and the measuring instrument is of the utmost importance. A Bailey water cooled furnace draft connection with connecting piping arranged to compensate for stack effect and with drain for condensed water vapor is shown by Fig. 2.

The entire problem of open hearth fuel-air ratio control and furnace draft control consists of a number of individual problems which differ in each section of the country and in each plant with variations in furnace design, fuels available, charge constituents, and the desired analysis of steel in the finished product. Metering equipment and control equipment are invaluable for determining the best operating procedure for the following reasons.

1. A knowledge of the air supplied for combustion during the various stages of the heat is obtained, and a comparison of results can be made.
2. From definite information regarding the process the best operating procedure can be decided upon and definitely adhered to.

As a result of the intelligent use of fuel-air metering and control equipment and furnace draft metering and control equipment, the following savings may be expected:

1. A decrease in the time required to make a heat of steel.
2. An increase in furnace capacity.
3. A direct saving in fuel.
4. An increase in furnace life with decreased maintenance.

Combustion Control Apparatus Applicable To Open Hearth Furnaces

By G. A. MERKT
Manager, Combustion Control Dept., Morgan Construction Co., Worcester, Mass.

(1) Within the present century, furnace construction in general has become architectural. Not only very large furnace structures have been created but shapes and styles to suit accurately specified heating processes are to be found in amazing variety throughout our modern industrial enterprises. Simultaneously, relentless efforts have been made to reduce the appalling waste in the utilization of heat. Fuel economy is now a major consideration of furnace operation. Means for the conservation of heat are being employed. Furnace operation has been put under **control.** Furnace control, definitely harmonized with the character of the work contemplated, is today recognized as the most important feature of a modern unit and this recognition has resulted in an abundance of development not only of furnace design but more particularly also of auxiliary apparatus.

(2) While much remains to be done about ruling the combustion process of available fuels and improving the utilization of the heat thus created, a good deal of progress has been made in controlling these two functions of the furnace. The principal mode of attack is **regulation.** We regulate the fuel, the air, the draft, the production and we do this no longer with crude appurtenances nor by the free-lance judgment of the experienced eye but instead use more or less accurately calibrated valves, gates, power drives, adjusted for the desired co-operation by scientifically established meters registering the rates of flow, the conditions temperature, the analysis of the combustion products, the required properties of the material which is being treated by the furnace, etc.

(3) Present day diversity in the practical art of engineering very naturally has led to tying together the functions of regulating to the registrations of meters resulting in **automatic** regulation and thus in automatic furnace control. Revolutionary economies from greater regularity of useful production and more efficient utilization of fuel or heat have been obtained in literally thousands of different industrial furnaces, which, having become machines, are no

longer suffering from the mysterious antics of the primitive fire pots.

(4) Considering these vast developments and their almost habitual use in the industrial furnace field it is, at first glance, somewhat puzzling why the open hearth furnace has not more generally benefited by the application of control apparatus along the lines above indicated. It is of course, a foregone conclusion that the steel maker is fully aware of the importance and benefit which regulation of the combustion process and controlled utilization of the created heat have on the economic operation of this type of furnace. His cautious attitude toward adoption of the scheme in the measure in which it is used in the general furnace field is however easily understood when we point out the special conditions not covered by the apparatus which is adequately serving the needs of other types of industrial furnace.

(5) These special conditions are, first: an unmeasurable rate of load, second: the need of unusually high furnace temperatures. Other exceptional conditions inherent to open hearth operation are incidental with these principal characteristics and, together, they furnish the direct causes of the difficulties involved in any effort of regimenting this furnace with other completely controlled furnaces. Whereas it is comparatively simple to coordinate the combustion rate of most industrial furnaces, particularly heat treating, certain processing furnaces and steam boilers, with any chosen rate of load, we have an entirely unknown quantity in this respect when we examine the work of melting and refining steel. The best rate of fuel combustion that can be used is that which is a maximum without damage to refractories. Owing to chemical reactions, during the steel making process neither fuel gas analysis nor heat absorption in the bath remain anywhere nearly constant, so that the indications of meters registering the contents of either oxygen or carbon dioxide in the furnace waste gases cannot be translated into automatic regulating impulses without continual supervision of an experienced steel maker. Aside from the maintenance of safely extreme furnace temperature there are no measurable earmarks of the load on the furnace and changes in the combustion process which may be desirable during the period of making a heat of steel are also governed by the chemical condition of the furnace charge, for instance during liberation of CO from the bath.

(6) A certain amount of automaticity in the manipulation of regulating devices is undoubtedly of practical value also in open hearth furnaces. The accuracy and reliability of regulation however depends largely upon the design and arrangement of the regenerative system, and the devices used for the purpose of regulation (control). In order to regulate any quantity there must first of all, be a surplus. Secondly, there must be as little leakage as possible either to or from the quantity. And, finally, the means of regulation must be sensitive and not critical, i.e. it must be capable of graduation over a practical range of scale. An open hearth furnace equipped with these properties of regulation can be handled with more intelligence and less random experimentation by the operator who, be he melter, engineer or metallurgist, remains the final authority on the question of relative adjustment, in other words, on the selection of proportions during ever changing requirements of proportional conditions.

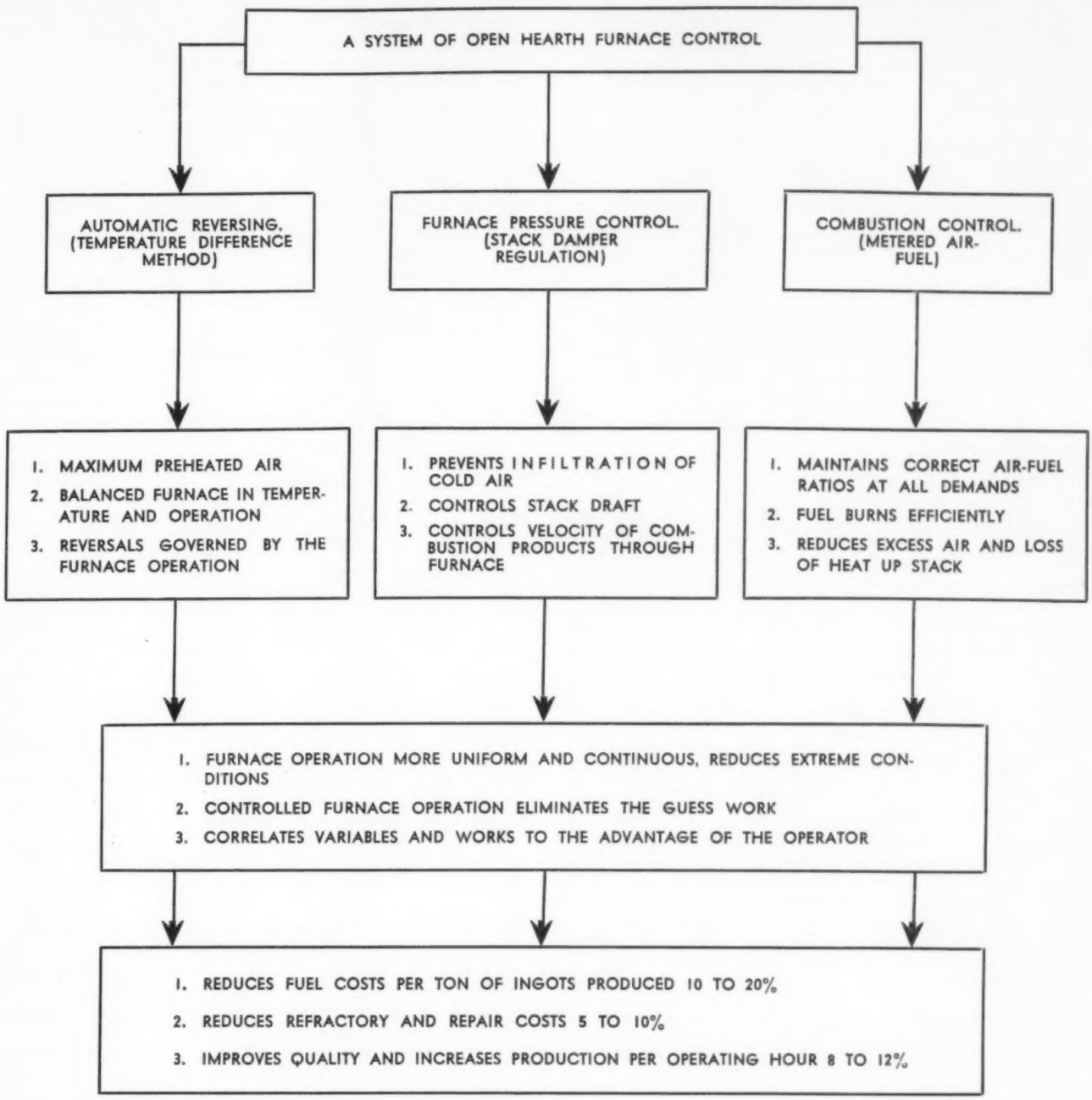
(7) Improvements along these lines have been made during the last decade by substituting mechanical draft for the limited and unruly natural draft of the heated stack; by insulating and plating the regenerative system against leakage of heat and infiltration and, in some cases, by complete separation of the two ends of the system; by replacing the weak air supply depending upon the pull of the furnace with forced air from a blower; and by providing the necessary measuring instruments which indicate the ensuing conditions of fuel flow, of furnace pressure, of furnace gas composition and temperature at strategic points in the system, to assist the operator in his judgment of the requirements for readjustment. Depending upon the degree of excellence with which these improvements have been made, satisfactory or highly satisfactory results are reported in a number of installations.

(8) Considering the open hearth furnace in particular it may be said that full automatic combustion control in connection with the present state of the metallurgical—chemical process of making steel is depending for its success upon careful supervision by technically trained personnel. Even then, close co-operation and frequent consultations with the furnace operator are necessary in order to provide for all varieties of operating requirements and for the constantly altering physical condition of the furnace itself. On the other hand, it has been ascertained that control of the furnace by reliable means of regulation is of the greatest importance for economic operation. Since there are no sudden and unheralded load changes to be expected in this operation, adjustments made by the operator are always on time and, if his judgment is fortified by access to continuous records of instruments registering the principal factors involved in proper furnace control, the ultimum of economy may be expected provided he is a steel maker.

Open Hearth Furnace Control

By M. J. BRADLEY
Leeds & Northrup Co., Philadelphia, Pa.

The control of an open hearth furnace has to take into account many variables, not only in design and construction of the furnace but also its equipment and operation. The practice required to produce different kinds of steel demand controlled conditions in order to produce economically a quality product. Starting with a correct charge, the operating conditions which have to be controlled during the melting down, working and finishing of the heat, include temperature, reversing, furnace pressure and combustion. Each of these conditions play a very definite function but each is inseparately related and greatly affects the others in the furnace operation. The last two


A SYSTEM OF OPEN HEARTH FURNACE CONTROL
AUTOMATIC REVERSING. (TEMPERATURE DIFFERENCE METHOD)
FURNACE PRESSURE CONTROL. (STACK DAMPER REGULATION)
COMBUSTION CONTROL. (METERED AIR-FUEL)
1. MAXIMUM PREHEATED AIR
2. BALANCED FURNACE IN TEMPERATURE AND OPERATION
3. REVERSALS GOVERNED BY THE FURNACE OPERATION
1. PREVENTS INFILTRATION OF COLD AIR
2. CONTROLS STACK DRAFT
3. CONTROLS VELOCITY OF COMBUSTION PRODUCTS THROUGH FURNACE
1. MAINTAINS CORRECT AIR-FUEL RATIOS AT ALL DEMANDS
2. FUEL BURNS EFFICIENTLY
3. REDUCES EXCESS AIR AND LOSS OF HEAT UP STACK
1. FURNACE OPERATION MORE UNIFORM AND CONTINUOUS, REDUCES EXTREME CONDITIONS
2. CONTROLLED FURNACE OPERATION ELIMINATES THE GUESS WORK
3. CORRELATES VARIABLES AND WORKS TO THE ADVANTAGE OF THE OPERATOR
1. REDUCES FUEL COSTS PER TON OF INGOTS PRODUCED 10 TO 20%
2. REDUCES REFRACTORY AND REPAIR COSTS 5 TO 10%
3. IMPROVES QUALITY AND INCREASES PRODUCTION PER OPERATING HOUR 8 TO 12%

determine the atmosphere in the furnace and, in a large measure, the heat transfer to the bath.

It has been demonstrated on open hearth furnaces that these conditions can be controlled much more consistently by the operator when he is provided with a system of control equipment which functions automatically and in a definite tied in sequence. For instance, if he changes the fuel on the furnace the control equipment should regulate automatically the air supply for combustion and the stack damper position to meet the new conditions. It is possible for the operator, if the furnace is equipped with recording and indicating instruments, to make the correct changes manually in the air supply and stack damper position to balance the fuel change. However, these changes would have to be made in succession, not immediately as when done automatically. The operator is trying to approach automatic regulation. In most cases, when not done automatically, the fuel alone is changed while the air supply and stack damper are neglected. Consequently the combustion and furnace pressure are incorrect. The automatic control equipment tieing in the variables in combustion, pressure, reversing, etc., etc., is simply a working tool for the operator to control efficiently the operation of the furnace.

An automatic system of open hearth furnace control at present in operation on several furnaces is shown in the following schematic diagram. It consists of three separate but definitely inter-related units. Any one may be applied to the furnace as a separate unit. However, the maximum efficiency in operation is obtained when the three units are definitely tied together in sequence and operation. For example control equipment may be installed and work correctly to maintain the furnace pressure conditions but due to excess air for combustion or unbalanced temperatures in the checker system, no improvement in furnace operation or fuel saving might result. It is the variations in the uncontrolled conditions which makes it practically impossible to duplicate the results of furnace pressure control equipment alone on one furnace with another. Analogous conditions are encountered when tests are made on temperature control, combustion control, or reversing control, when applied individually.

Automatic Reversing

Automatic reversing insures that the reversing operation is started at the correct time; completed in the shortest time possible; and in a definitely tied in sequence. It is important to keep the flame on the open hearth furnace as continuously as possible. It is calculated that a fuel saving of around $700 per year may be obtained for each second saved during the reversing operation. Furnaces are being reversed automatically as quickly as possible, in fact on many furnaces it requires only from six to nine seconds to complete the reversal. The temperature difference method, actuated from the two ends of the furnace results from the temperature conditions within the system. It keeps in step with the progress of the heat and the life of the furnace and prevents extreme temperature variations on the refractories. It maintains the same temperature cycle in the preheated air supplied on the two ends of the furnace, and ties in with the combustion control by insuring the same rate of combustion from each end. It stabilizes by an inter-locking tie-in both the combustion and furnace pressure controls by keeping them at the last set position until the reversing operation is complete.

Furnace Pressure Control

Furnace pressure control maintains automatically the furnace pressure by regulating the stack damper and waste heat boiler fan and insures a uniform pressure condition within the furnace regardless of changes in the amount of fuel used or weather conditions. It is in effect the control of the flow of outgoing waste gases at a rate which corresponds to their formation from combustion. This definitely limits the amount of infiltration of cold air into the furnace and tends to consistently maintain the shape and position of the flame in the furnace. The furnace pressure control ties in with the combustion control by insuring that the maximum amount of combustion air is supplied through the regenerative system, preheated, and metered.

Combustion Control

Combustion control or metered fuel-air ratio control insures that the correct volume of air is supplied for the amount of fuel burned. It also insures that when a change is made in the fuel supplied a corresponding change is made at the same time in the air supply. The relationship between the fuel and air is thus maintained in correct proportions to reduce losses due to incomplete combustion or carrying away of heat up the stack by excess air. Efficient operation requires simultaneous adjustment of the fuel and air. When the controls are operated manually even the first helper with the complete set of instruments, as a guide, cannot make the required adjustment simultaneously. Automatically, the various adjustments are made simultaneously.

A system of combustion control is in operation in which the air supply for combustion is automatically regulated from the analysis of the products of combustion. The operator regulates the fuel supply manually while the air is automatically adjusted to keep in step with the fuel to maintain the set conditions. Obviously as required in all combustion control the furnace pressure must be controlled accurately. In another system of combustion control the air supply is regulated manually from the oxygen content of the waste gases.

Temperature Control

Temperature control of the inside surface of the roof is installed on many open hearth furnaces. This is accomplished by installing a radiation pyrometer on the roof of the furnace and have it actuate a recording controller which in turn operates to cut back the fuel automatically when the inside of the roof has reached the set safe working maximum temperature. The controller is also provided with an indicator to show the operator when the set temperature of the furnace is being approached. In practice, the temperature of the furnace is brought up as rapidly as possible during the melting down stage and held just below the safe working maximum throughout the heat. Equipment is available to measure the bath temperature just before tapping and also the temperature of the metal as it is being teemed.

Insulation of the complete furnace system has greatly improved the control of open hearth furnaces. It decreases the loss of heat by cutting down the radiation losses but what is also equally important it seals the furnace system preventing infiltration of cold air thereby improving both the furnace pressure and combustion control.

Unfortunately in the development of control equipment the whole problem has seldom been taken into consideration. Overemphasis has, in most cases, been placed on individual phases of the complete problem and the results have often been discouraging due to the variations in the uncontrolled phases. Where indicating and signalizing systems have been installed to warn the operator when and what to do the results have seldom warranted the expense of the units. The signals demanding his attention calls him from more important work connected with the furnace operation. If he is responsible for the accuracy of the signalizing system he would probably be more efficient if left entirely to his own judgment. For instance in the case of a time signal for reversing if he has to change the interval between signals in order to balance the furnace he would probably be more competent in reversing without the signal

system. Experience has demonstrated that best results are seldom obtained when the responsibility is divided between an automatic device and the operator. It is safe to predict that all open hearth furnaces in operation will, in the very near future, be controlled automatically.

Automatic Combustion Control of Open Hearths

By W. M. SHALLCROSS
President, Shallcross Control Systems Co., Milwaukee, Wis.

There is a tendency in the development of these controls to make them too complicated—to produce controls which will try to do too much of the operator's thinking.

An open hearth, like our automobile, cannot be run by a Robot. An automatic control could possibly be designed to drive our car—with gyro compass to hold its course, with electric eyes to see the red and green lights, and with microphones to hear the traffic cop's signals, but we wouldn't trust ourselves to ride in it.

There was the German professor who set out to devise the perfect concentrated food. Years of work produced a result completely satisfactory, with only one defect—it wasn't fit to eat.

Under present conditions in open hearth plants and with the present state of the control art we should consider only those controls which accomplish these aims:

1—to improve the quality of the steel,
2—to economize the fuel,
3—to prolong the life of the furnace or regenerators,
4—to relieve the operators of routine adjustments.

Any control equipment which does not accomplish one or more of the above cannot be justified

The various controls applicable to an open hearth, with their principle justifying qualifications as listed above, are the following:

A—Fuel Pressure Controls, delivering uniform flow of fuel, because they:
2—economize the fuel,
4—relieve the operators of routine adjustments.

B—Fuel Mixing Controls on mixed fuel furnaces, because they:
1—improve the quality of the steel,
2—economize the fuel,
4—relieve the operators of routine adjustments.

C—Combustion Controls, mixing the proper amount of air with the fuel, because they:
1—improve the quality of the steel,
2—economize the fuel,
4—relieve the operators of routine adjustments.

D—Furnace Draft Controls, maintaining a uniform furnace pressure, because they:
2—economize the fuel,
3—prolong the life of the furnace or regenerators,
4—relieve the operators of routine adjustments.

E—Reversing Controls, automatically reversing the furnace on either a temperature or time cycle, because they:
2—economize the fuel,
3—prolong the life of the furnace or regenerators,
4—relieve the operators of routine adjustments.

At the present time there are no other applicable automatic controls that are considered justifiable.

Above all—any controls on an open hearth must be extremely rugged, simple, with 24 hour a day reliability, and must be as nearly fool-proof as possible. In no part of a steel plant outside of the research laboratory is a laboratory instrument at home. The maintenance man is more familiar with his hammer, screw driver and pliers than he is with a watch maker's tool kit.

Lubrication of Hot Strip Mills

By C. J. DUBY
Chief Engineer, Republic Steel Corporation, Warren District, Warren, Ohio

During the past few years, considerable stress has been laid upon the importance of proper and adequate lubrication of the various units of the continuous hot strip mill. Before the advent of the continuous wide strip mill, roll neck bearing pressures were comparatively low, and, therefore, no particular attention was given to the lubricant or the method of its application. However, we now have the wide strip mill, and this subject is one of grave importance and requires careful study.

Due to the continuous rolling of wide strip in the light gauges, with the present day reductions, the unit pressures on the roll neck bearings and gear drive teeth have become exceedingly high, and considerable care and diligence must be exercised in selecting the proper lubricant and method of application for the various parts of the mill and drive.

One of the contributing features for the success of the continuous strip mill, for rolling wide strip steel in light gauges, is the 4-high roll stand, equipped

with roller bearings properly lubricated with oil or grease.

When using oil as a lubricant in circulating systems, many of which are now in operation, the lubricant should be applied in the most efficient manner, and filters should be installed to remove foreign matter, and means should be provided where necessary to maintain the lubricant at the proper temperature. Further, considerable care should be taken to exclude water and foreign matter from the lubricating system. It is very difficult to prevent some water, scale, sand, and other foreign matter from entering the roll neck bearings. There are several seals on the market, which have been developed for roll neck chucks, which, we believe, will minimize this difficulty.

On the 2-high plain bearing stands and the edgers, comprising what is known as the roughing mill, and where it is very difficult to exclude water from the

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bearings, it is obvious that the lubricant used must be of such nature that it will not emulsify readily in water, and, where the bearings are open, the lubricant must have sufficient body to exclude foreign particles from the journal.

In the drive units, the lubricants should be selected to suit the character of the contacting surfaces which are to be lubricated and protected from wearing and the unit pressures on these surfaces. Where the gears operate openly, the lubricant should be of such type as to adhere to and have sufficient body to protect the wearing surfaces under the operating pressures. Where the drive gears are enclosed in a housing, it is usually more convenient, where conditions permit, to use the same lubricant for the bearing and gear teeth. The lubricant should have sufficient film strength to withstand the unit pressures between the contacting surfaces.

The question of proper lubrication often becomes a serious problem where the mill drive is loaded greatly beyond its rated capacity. In all lubrication systems, it is very essential that the lubricant, to obtain the best results, should be applied at the proper place, and, in the case of gears, as near to the point of contact as possible, and that supply must be continuous, clean, and at the proper temperature.

Where roller bearings are used on the roll necks, a good safe-guard is to provide thermocouples and a recording pyrometer to record the temperature of each bearing for the full 24-hour day. Signal lights and warning signals should be provided in order to give an alarm, should the bearing temperature exceed a predetermined amount. One of the principal reasons for this warning signal is to place the operators on guard so that they may determine whether the rising temperature is due to a failure of the lubricant supply or the beginning of a bearing failure. If the heating up is due to the latter, the bearing may be removed before any considerable damage is done, so that the bearing can be checked up, and, if necessary, returned to the manufacturer for repairs. Taking these precautions will, most certainly, help to reduce the bearing costs on the mill.

In designing and installing pipe connections to roll neck bearings for lubricating systems, it is important that they be made so that they can be readily disconnected in the least possible time so as not to delay the roll-changing time.

Lubrication of Mill Tables

By FRANK L. GRAY
Lubrication Engineer, Illinois Steel Company, Gary, Ind.

The conditions under which mill tables operate are of such a variety that due consideration must be given the lubricant that is to fulfill these demands.

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Tables will operate at a lineal speed of 75 to 1,730 feet per minute. Mill dirt, gritty dust, water and scale are always present. Temperatures up to 1,000° F. have been recorded within the bearings. Salt,

steam, or high pressure water are used for the removal of scale on plates and strips and have their effect upon the lubrication of the tables. On reversing or three-high mills the lubricant must maintain a film under the reversing action and shock of slab turning.

In latter years the mill designer has given more attention to these conditions and has greatly simplified our lubricating problems. Previous to this innovation in design, it did not require a lubricating authority to specify black oil for the plain bearings and gearshield for the open gears. However, with this type of construction still prevalent in our mills, it is our duty to improve the quality and care of lubricant, and the method of application.

In the lubrication of the tables of the older types of mills with their plain bearings and open gears, black oil and gear lubricant have proven their worth, not only in the light of economy, but also in protection offered. Gear lubricants have been developed to a remarkable degree of proficiency in the protection of open gears in the presence of the many and varied conditions. The method of application has been corrected to eliminate waste and to put the product in use with the fewest detrimental factors possible.

The gear lubricant for open gears must adhere tenaciously to the tooth surface, resist the high speed centrifugal force and withstand pressures, thereby minimizing wear. Heaters for the gear lubricant make possible its application at correct temperatures without loss of time or waste of product. Inefficient methods of removing the product from the barrel are also eliminated. Pans placed under the gears at the point of mesh reclaim the drippage and tend to keep the surroundings clean.

The plain bearing and exposed gear are being antiquated by the roller bearing and enclosed gear. The roller bearing with its pressure gun fitting makes it possible to apply the grease in the same clean condition it leaves the grease factory. Contamination is eliminated.

Due to the heat of rolling a soda base grease will not only withstand higher temperatures, but will return to its original consistency. The lime base grease has a tendency to separate when exposed to higher temperatures.

In slabbing or blooming mills it is sometimes the practice to push the hot slab over the table bearing to the cooling bed. Under these conditions, where it is not possible to water cool, temperatures within the bearing will reach 1,000° F. No oil or grease will withstand this heat. If a lubricant is used it will oxidize and leave a solid residue. The evaporation of the oil, if restricted, may build a pressure high enough to cause damage. Under these conditions, roller bearings can and should be operated dry.

Enclosed gears are free of the dust, dirt, scale and water that are the common enemies of mill table gear lubrication. A fluid gear lubricant compounded with a low cold test oil and possessing good adhesive properties should be used. This lubricant will give a strong lubricating film and stick to the gear teeth, yet it will be fluid enough and will have the lubricating qualities that will not make it detrimental to bearings.

On the smaller high speed mills the table rolls are driven by either canvas belt or individual motor with roller bearings. These offer no lubricating problems. The belt needs no lubrication and the small motors are greased with petrolatum only after long intervals.

The lubrication of mill tables, like other steel mill equipment, has been greatly simplified by the interest of the designer in the lubricating requirements for the equipment he passes on to the mill operator.

Lubricating System For Rolling Mills

By W. D. HODSON,
President, The Hodson Corporation,
Chicago, Ill.

The lubricating system, as manufactured by our company, is designed especially for the heavier types of rolling mill and similar equipment. It fulfills the maximum lubrication demands of the heaviest service with a flexibility of quantity of grease and application periods with a high degree of efficiency and directness.

W. D. HODSON

A. The grease, or greases, are delivered to the bearings in the original condition as produced by the manufacturer.
B. In regulated amounts as needed.
C. At sixteen different predetermined periods, adjustable from a few seconds to hours.
D. By the most direct method possible.
E. The human element is eliminated to a great extent.

The lubricating system consists of a pressure grease tank, of 100 pounds or 200 pounds capacity as desired; one or more lubricator units of four

valves each; and an electric control panel which regulates the periods of application of lubricant to the bearing.

The lubricator unit is made from solid steel forgings, and is designed to stand up indefinitely under the most severe mill use, even much abuse. All openings and passages are large. The smallest opening being 9/16" in diameter. All moving parts, except the air cylinder linings which are made of brass, are made of hardened steel which have longer life than brass parts.

Pressure grease tanks are fitted with a follow block, providing a uniform pressure against the grease, with a content indicator extending through the top. The indicator may be provided with a light or bell alarm if desired.

The electric control panel is a special feature of this system, which is adjustable at the will of the operator from six seconds to sixty minutes—sixteen different periods. Therefore, each mill can be lubricated at the period most suitable for its requirements and the period may be changed readily to meet the varying conditions from time to time. As an example, for an extra heavy run or when starting up after a shut down; each mill or each unit of a mill, or individual bearing if necessary, according to its requirements.

A separate paragraph is justified in stating that this time period adjustability permits of the lubrication of the thrusts much more efficiently than is possible in any other way, by applying the lubricant in very small quantities at very frequent periods. Therefore, no matter how great the thrust load may be, if the proper type of grease is used and the periods of application are properly adjusted, there should be continuous lubrication of the thrust. The decreased wear as a result of this superior method of lubrication should soon absorb the entire cost of the lubricating system through the savings in bearings.

The power used is compressed air, which may be taken off at any point or points desired, either from the plant system or a separate small compressor.

The air consumption is exceedingly low, averaging .1121 cu. ft. free air per cycle per lubricator of four valves, plus the air through the exhaust lines.

The piping of the system is also in keeping with steel mill equipment. There is a separate grease line direct from the lubricating valves to each individual point to be lubricated. The simplest and most efficient method yet developed. Ordinary storeroom pipe and fittings are used.

There are no pumps or high pressures, long lines or manifolds or valves in series to cause the grease to break down.

Large passages and grease lines insure a uniform and efficient operating condition at low temperatures, reduce line friction and protect the grease against destructive pressures.

An oiler, one for each shift, stationed at every bearing, could not equal the lubrication service of our lubricating system. Stated with the utmost briefness, this system fulfills to a remarkable degree all the chief requirements of automatic lubrication.

Trend of Development of Lubricating System

By R. M. GORDON
President, R. M. Gordon & Company,
Pittsburgh, Pa.

The automatic lubrication of hot sheet and tin mills has been the contribution of our company to the industry. Since the early days of sheet and tin plate making, these mills have been lubricated either by chunking or swabbing. Numberous attempts have been made by various companies in the past ten or fifteen years to improve the method of lubrication on these mills, but until the last two years, roughly speaking, little progress had been made. Now, however, these mills, like all other rolling mills, are being successfully and economically lubricated by centralized lubricating systems. In one instance, five hot finishing mills, five roughing mills and six cold finishing mills are now being lubricated from a single centralized system.

The experimental and development work necessary in accomplishing this improvement have governed the trend of development for our company. Extreme ruggedness, unnecessary in the lubrication of any other type of rolling mill, has been built into the system we manufacture. Greater flexibility, permitting individual as well as quick and easy adjustment at each mill contained in a group comprising a centralized system, has been a necessary improvement. It is now possible to supply positively, a measured quantity of grease to each of a group of mills at any desired time interval from 5 seconds to 2 hours. This adjustment is at the finger tips of the roller or operator, is visible, and requires but an instant to make.

Greater centralization was needed. In hot mill work, it is desirable to lubricate a train of rolls from one central distributing point. Due to the type and quantities of grease used, it is not feasible to lubricate these mills with a number of small distributing units. This need brought about the development of an entirely new type of grease pump. In the first place, a larger pump, having a larger reservoir and capable of supplying more grease at a greater pressure than was ever required, became a necessity.

With this as a background, we have developed our present pump; a unit weighing about 2000 pounds, with a hopper holding 1000 pounds of grease; capable of supplying grease to an almost unlimited number of mills within a radius of three or four

hundred feet from the pumping unit, at pressures up to 5000 pounds per square inch. This pump has the new and exclusive feature of a barrel lifting and emptying device, making it possible for the operator to pick up a full drum of grease and empty it into the hopper in a few minutes' time without the aid of a crane or any additional labor.

An additional safety feature is provided with this pump, in that it is of two phase construction; the arrangement being such that should one phase become contaminated or inoperative for any reason, it can be replaced or cleaned without interfering with the operation of the pump, as either phase is fully capable of supplying grease to all of the bearings in any system.

The last notable improvement has been the chromium plating of the self-indicating displacement valves, which measure the grease fed to each neck or bearing. Experiments have proved that chromium plated or nitrided surfaces are the only ones that will resist scale abrasion in grease valve work. It is a physical impossibility to exclude all scale from the lubricating system even when scale free pipe is used. The scale dust in the air is sufficient to render the valves unfit for service after several months of hot mill work. After considerable development work, we succeeded in successfully chromium plating both the cylinder walls and the plungers in the displacement valves, and we have now in service a number of chromium plated valves which have operated over a half-million times, pumping a grease which was never successfully pumped before, at 2000 pounds pressure, that are still in perfect condition. The developments necessitated for hot mill work have been adopted for lubricating all other types of mills.

Composition and Lignum Vitae Roll Neck Bearing Progress

By L. F. COFFIN
Superintendent of Mechanical Dept., Bethlehem Steel Company, Sparrows Point, Md.

The years 1933 and 1934 have seen the extension of the use of composition bearings to the heavier duty and larger mill field. This development has met with some surprisingly successful results and with some equally disappointing experiences. That composition bearings are a definite improvement in bearing applications in small high speed mills can be stated with authority as evidenced by their widespread successful use in this field; saving power, reducing roll breakage, improving section and reducing bearing and lubrication costs.

L. F. COFFIN

In the larger mill and heavier duty field, however, results are not so definite. In a Three-High 110" Plate Mill, a composition bearing has been in service on the top roll continually from August 30, 1933, to the date of writing this article with a total wear of less than 1/16". In this same mill, however, it has not yet been possible to secure more than two weeks life from similar bearings on the bottom rolls despite the use of different types of scale guards, and different methods of water application. When this mill formerly operated on all brass and babbitt bearings, the top bearings had much shorter life than the bottom.

Applications of Composition Bearings to Blooming Mills have met with sufficient success to warrant determined efforts to make them successful on every installation.

In a 60" Universal Plate Mill on the other hand, lignum vitae top roll bearings were used continuously for 21 months until they suddenly refused to function, due probably to an increase in the work they were called upon to do. It is interesting to note and may be of some significance in future developments, that lignum vitae bearings (which are still used quite extensively and economically in small high speed mills) give a much higher polish to a roll neck and will operate on a rougher neck than will bakelite impregnated canvas.

There is however an application of this type of bearing that was made in 1933 that should lend encouragement to manufacturers and users who have their eyes on the heavy duty field. A Three-High Jump Sheet Mill has operated continuously since November 2, 1933, to date of writing this article, on composition bottom and middle roll bearings. The average life of bottom bearings has been two months, with considerable variation in the life of the individual bearing. The original middle roll bearings are still in service.

Some of the conditions in this mill are as follows:

Top and Bottom Roll dia.	32″
Middle Roll dia.	18″
Top and Bottom Neck dia.	24″
Middle Roll Neck dia.	12″
Projected Bearing Areas for bottom roll	205.71 sq. in.
Rolling Speed on Bottom Roll	30 R.P.M.

When rolling 38″ long x 12″ wide x .5937″ thick sheet bar, the following conditions were noted:

		EXTENSION OF BAR		
		Enter	Leave	% Reduction
	1st	12″	23″	48
	2nd	23	30	24
	3rd	30	39	23
Double	4th	39	59	34
	5th	59	80	30

Finish size 38½x80″x.1784

If these conditions are applied to the formulas developed by Ekelund and published in a series by *"Steel"* commencing with the August 21, 1933, number, the astounding figure of 7,313 lbs. per sq. in. or 3,012,942 lbs. rolling pressure is secured for the first pass and for the fifth pass a rolling pressure of 3,847 lbs. per sq. in. or a total rolling pressure of 1,585,040 lbs. It is probable that these results are too high but may reach the figure of 6,500 lbs. per sq. in.

Undoubtedly this application is the most severe within the writers knowledge and calls for bearing pressures far higher than are encountered in the conventional plate or blooming mill.

Such results indicate that it might be possible to make a successful application on nearly any kind of rolling mill if sufficient research were conducted to determine definitely such points as proper method of water application, allowable arc of contact for various diameter necks, uniformity and reliability of manufacture and many others that affect bearing design and life.

Anti-Friction Bearing Progress In Steel Mill Equipment

By JOHN L. YOUNG
District Manager, Timken Roller Bearing Co.,
Pittsburgh, Pa.

In the development of anti-friction bearings in the steel industry during the past year the outstanding feature is the extensive use of roller bearings in connection with the blooming mill, hot strip mill, and cold strip mill being built by the United Engineering & Foundry Company for the Ford Motor Company, Detroit, Mich.

The same size four row adjustable tapered roller bearings are being used on the back-up rolls of the hot and cold strip mill. These bearings are 25½″ inside diameter by 40½″ outside diameter by 22¼″ long. Each bearing weighs a little over two tons.

The work roll necks are also equipped with four row adjustable tapered roller bearings.

The screwdown mechanisms of the blooming mill and hot and cold strip mills are mounted on tapered roller bearings, including the vertical worm wheel shafts of the blooming mill, which have bearings 24″ inside diameter by 32″ outside diameter on both the top and bottom positions.

All gear drives, including the main mill drives, except the pinion stand of the blooming mill, are mounted on tapered roller bearings, as well as the table rolls and accessory equipment. All table rolls have a double tapered roller bearing at the mitre gear end and a cylindrical roller bearing at the floating end. This will be the largest, most completely anti-friction bearing equipped steel mill in the world when it is completed.

Aside from the Ford project the following developments have taken place:

Practically all of the mill type cranes that have been purchased during the last year have been anti-friction bearing equipped and at more positions than in the past.

The demand for anti-friction bearing mill motors has also increased.

Several piercing and elongating tube mills have been built using roller bearings throughout.

The reversing single stand hot strip mill of the Steckel type has been developed to the application stage with a 4-high wide mill installation in the Chicago District and a 2-high narrow mill installation in the Detroit District.

A great amount of thought and experimenting has been going on during the past year with planishing mills, especially the changeover of old plain bearing mills to anti-friction equipped mills for planishing. Both cylindrical and tapered roller bearings have been used.

The rolling of tin plate by both the continuous tandem and the reversing single stand cold mill has progressed rapidly. One of these single stand reversing tin plate mills uses the largest capacity roller bearings ever built for a rolling mill. These bearings are of the four row tapered roller type and are 30″ inside diameter by 48″ outside diameter by 32″ long. Each bearing weighs a little over four tons.

During the past year, two of the largest roller bearing equipped 4-high mills were installed in the Chicago District. These mills are 20½″ x 56″ x 84″, using two row tapered bearings, 30″ x 51″ x 25½″, on the back-up roll necks and at the present time there is a trend toward even larger mills and larger bearings.

Improvements In Application of Bearings To Rolling Mills

By GUNNAR PALMGREN,
Chief Engineer, S. K. F. Industries, Inc.,
Philadelphia, Pa.

During the past year our company has introduced on the market simplified roll neck bearing designs for both ordinary hot rolling mills with grooved rolls and cold rolling mills, after having tried them for years in rolling mills.

The outstanding feature in the new designs is that the bearings are mounted with a loose fit on cylindrical necks and that arrangements are made for supplying lubricant to the surface between roll neck and bearing inner races in order to prevent wear or smearing on the neck. The simplified designs are cheaper, more compact, easier to obtain room for in existing stands, and last but not least, can easily be adopted on existing plain bearing roll necks after only slight modifications of neck dimensions.

Fig. 1 shows a design for the common hot rolling mills with grooved rolls. Two spherical roller bearings are mounted side by side on each neck. The bearings on the righthand neck carry radial load only. On the other neck, as is shown in the illustration, the one bearing is made heavier so that it will carry not only half the radial neck load, but also the thrust load.

In this bearing it may be observed that a split outer race is used and so applied that the two outer races can be adjusted in order to eliminate all internal looseness, with the result that the bearing then locates the roll accurately in an axial position.

The bearing housings are so made that the radial load is always applied between the two bearings, which means that the bearing housings can tilt according to the bending of the necks, and each of the two bearings on the same neck carrying always half the neck loads.

The bearings are located on the neck by means of crown-shaped sleeves secured to the ends of the rolls and so formed that the wobbler can be pushed outside of the sleeve and contact with the driving surfaces on the neck. The bearings are mounted in the housings as complete units with adequate protection against water and scale.

The roll necks of 122 stands of bar, rod, tube and strip mills have been equipped with our self-aligning bearings since the early part of last year, so that the total number of stands in operation on our bearings in these types of mills is now 412.

Similar improvements have been made in the designs for back-up rolls in cold rolling mills. The mounting is substantially the same as described above for the hot rolling mills, the difference being that in most cases all of the bearings are of the same size and that a circulating oil system is used, with the result that the oil which lubricates the bearings is admitted by a rotating ring at the end of the roll neck to the center hole of the roll, and then to the surface between the roll neck and the inner races of the roller bearings.

Where very stiff back-up rolls are necessary the diameter of the rolls must be, of course, large, and the neck diameters must also be as large as possible. In this case a design with two bearings per neck, but of different sizes, as shown in Fig. 2, has been found to be the best and most economical. The load is applied on the bearing housing in such a way that the heavier bearing gets a larger part of the total neck load in proportion to the capacity of the two bearings with the result that the life of all of the bearings will be about the same.

This design is the best compromise between the required largest possible neck diameter and the largest possible bearing capacity within certain limited space.

The same principle can also be used to advantage on rolls in ordinary two-high cold rolling mills where the same requirements exist, but in this case the roll necks must, of course, be coupled to the pinion stand.

There has been some discussion as to the use of a single bearing having two rows of rollers instead of two bearings with four sets of rollers. The objection to the two-roller construction is the necessarily larger diameter of single bearing or for a speci-

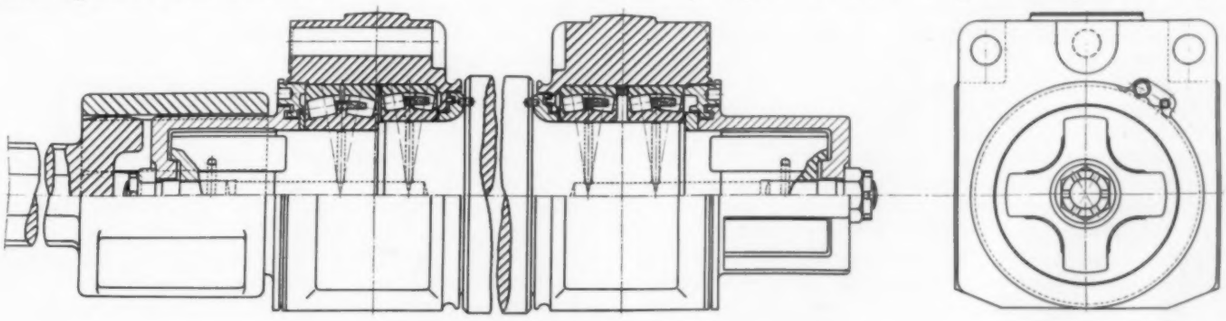


FIG. 1.

fied roll diameter a bearing with reduced capacity and shorter life. In the design with two self-aligning bearings, discussed above, the load is always automatically distributed on the four rollers quite uniformly. This is the case even if the roll necks are machined so that the diameters do not correspond

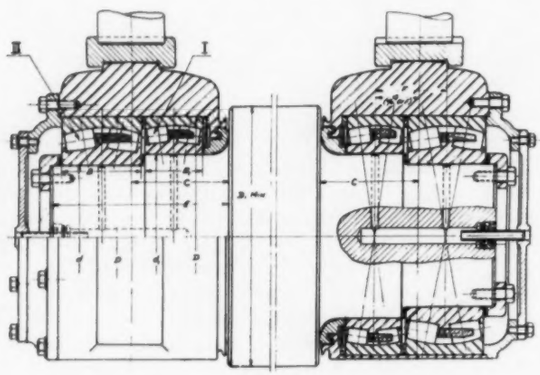


FIG. 2.

quite to the bearings as illustrated in Fig. 3, which has been exaggerated to show the conditions. If the smaller end of the neck is too small, as shown in the left figure, the load applied on the center of the housing and the reaction in the inner bearing tilts the housing and the outer race in the inner bearing until the outer bearing comes in full contact with the neck and carries the correct proportion of the total neck load, as shown in the right figure.

In the majority of stands equipped with our bearings two self-aligning bearings have been used side by side on the necks and in cases where thorough examinations have been made it has always been found that all the four rollers have carried the same load. Therefore, there is no reason when using self-

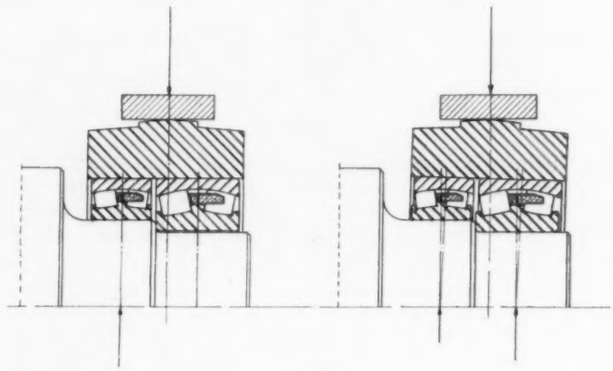


FIG. 3.

aligning bearings to eliminate the one bearing and use a two-row design with all its disadvantages.

The roll necks of 133 stands of cold rolling mills have been equipped with our self-aligning bearings since the early part of last year, so that there are now 398 stands of continuous four-high and cluster type mills and 233 stands of two-high and three-high mills in operation or a total of 1041 stands in hot and cold rolling mills.

Developments In Application of Anti-Friction Roll Neck Bearings

By A. H. FRAUENTHAL
Manager, Steel Mill Division, The Bantam Ball Bearing Company, South Bend, Ind.

Developments in anti-friction roll neck bearings during the past year have been confined to the internal structure of the bearings rather than to methods of mounting and enclosing.

The chief need for development in anti-friction bearings is increase in actual operating capacity in a small space and as there have been no recent developments in materials to permit higher unit stresses it has become necessary to use the available space to better advantage and to design types of bearings that have inherently better load distributing characteristics.

Internal construction developments have been quite marked in both the straight roller bearings and the tapered roller bearings.

In the straight roller bearing particularly there has been furnished to the industry during the past year bearings using much smaller diameter rollers than are customary. The most outstanding advantage of this design is the fact that more rollers can be used, resulting in a large increase in the number of inches of roller line contact, thus spreading the load over a large number of lines rather than a small number.

Another outstanding advantage of this type of bearing is that it permits larger diameter roll necks, thus cutting down the amount of neck deflection and the danger of roll neck breakage and for the same reasons permit old 2-high mills to be changed over from plain bearings to straight roller bearings using the old rolls.

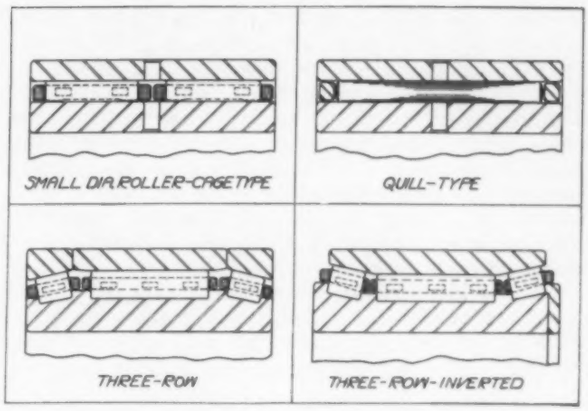
All of the space that can be gained by decreasing the roller diameter need not be added to the roll neck diameter. It is quite valuable to thicken the inner race and eliminate the permanent distortion caused by the rolling out of thin inner races.

All of the above advantages are also obtained with the Quill type bearing which is a bearing having as rolling elements relatively long and slender rollers in full complement without the use of cages

or separators. Various conditions in the industry have tended to popularize this type of bearing which is inexpensive and because of the small diameter rollers and the absence of a cage furnishes more roller line contact and more total roller projected area than any other type of anti-friction bearing in the same space.

In roll neck bearings and particularly with tapered roller bearings, there is considerable tendency for the load to concentrate on the row of rollers nearest to the roll barrel with the result that only a portion of the full length of the bearing is used. The various devices in use for promoting self-alignment in the bearing chocks are only partially successful and it is with the major idea of designing a bearing to inherently assist in the self-alignment as well as to furnish greater capacity in the available space that the two types of Bantam three-row bearings were developed.

Combining the high load carrying capacity in a restricted space of the straight roller with the thrust carrying characteristics of the tapered roller result in a high capacity thrust and radial load carrying bearing suitable for use on heavily loaded backing rolls without requiring an auxiliary thrust bearing.



For various types of work these bearings are made in two different styles as shown in the line drawing. The largest three-row bearing now in operation is 26½" ID x 42" OD x 25½" long, on a 4-high eversing cold mill.

Recent Developments In Steel Mill Applications of Roller Bearings

By D. E. BATESOLE
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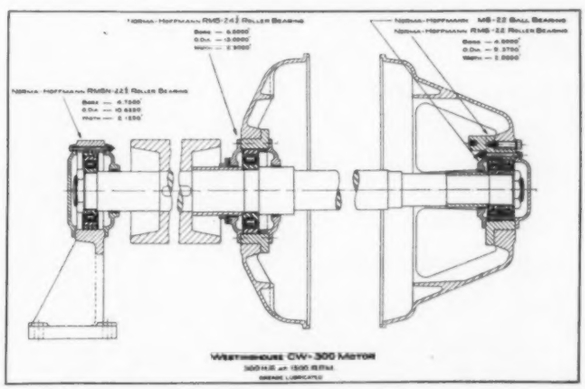
The past year has witnessed a number of favorable signs of increased activity in the steel industry and of these one of the most noticeable from the bearing standpoint is the extent to which old equipment is being modernized by applying the anti-friction bearings. In many instances revenues have not as yet been sufficiently large to permit the purchase of entirely new machinery, motors, etc., but there has been a sufficient loosening of the purse strings to allow Maintenance Departments to replace in many instances old type and inefficient sleeve bearings with grease packed ball or roller bearings.



In this work of rehabilitating old equipment the roller bearing of the short cylindrical type has been finding increasing favor due largely to the fact that it is so universal in its application. It combines heavy radial load capacity and resistance to shock load, with ability to operate at unusually high speeds with a minimum of friction and without undue heating. On certain electric motor applications this low friction coefficient at high speed has solved a number of troublesome bearing problems.

A typical heavy duty high speed motor changeover is that shown in the accompanying illustration. This is a 300 HP motor operating twenty-four hours a day at 1500 RPM and used to drive a hot saw by means of a three-ply leather belt which imposes a continuous and heavy load on the bearings. Due to the diameter of the shaft required to resist deflection, bearings of large sizes were found necessary. The peripheral speeds of the bearings are exceptionally high, the inner raceway speed of the largest bearing being 3290 feet per minute. The motor illustrated has been in service since early in 1929 and the temperature of the housings does not exceed 55° Centigrade, with a normal operating temperature closer to 40°C.

It will be observed that the belt pull is sustained by two large cylindrical roller bearings, one at each side of the pulley, the outboard bearing being of the self-aligning type. The endwise location of the shaft is taken care of by using a deep groove ball bearing at the front end of the motor, this ball bearing carrying no radial load however. A third roller bearing absorbs the radial load at this point. Each bearing housing has ample space for lubricant which in this instance is a very heavy bodied grease found after experiment to operate with less temperature rise than oils or various lighter grades of greases.

Where heavy load rather than speed is involved, the short cylindrical roller bearing likewise has its place in the industry. For roll necks, pinion stands, piercing mills and similar applications it is possible to use two and even three adjacent rows of short rollers with a common inner and outer ring to obtain the desired capacity. Such bearings can take care of conditions of slight misalignment which would often cause trouble with bearings using a single row of long rollers. In other words the possibility of "skewing" in the short roller type bearing is reduced to a minimum.

It is impossible to describe herein the many new and interesting problems presented by the steel industry in its search for improved bearing performance and lower maintenance cost. It is gratifying to note however that many of these problems are now being rapidly solved through the close co-operation not only of the bearing manufacturer and the user but of the lubricant manufacturer as well.

Tabulation of Applications of Anti-Friction Bearings to Roll Necks of Steel Rolling Mills of the U. S. A.

THE ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS PRESENTS HEREWITH A TABULATED LIST OF ANTI-FRICTION BEARINGS APPLIED TO ROLL NECKS IN THE IRON AND STEEL INDUSTRY.

THIS LIST WAS PREPARED AT THE NATIONAL OFFICES OF THE A. I. & S. E. E. UNDER THE DIRECTION OF THE SPECIAL COMMITTEE ON BEARINGS AND IS SUBMITTED TO THE IRON AND STEEL INDUSTRY WITH THE PURPOSE OF INDICATING ONLY THE PROGRESS BEING MADE IN THE APPLICATION OF ANTI-FRICTION BEARINGS TO ROLL NECKS.

THE ENGINEERING DATA AND INFORMATION FURNISHED IN THIS LIST, HAS BEEN SECURED FROM SO MANY SOURCES THAT IT MAY REQUIRE CORRECTIONS AND ADDITIONS FROM TIME TO TIME. THE LIST DOES NOT REPRESENT THE COMPLETE INSTALLATIONS IN THE INDUSTRY, HOWEVER OVER 90% OF THE STEEL MILL INGOT TONNAGE CAPACITY IS ACCOUNTED FOR.

THE ASSOCIATION WILL WELCOME CONSTRUCTIVE SUGGESTIONS ON ADDITIONS AND CORRECTIONS.

TABULATION of APPLICATIONS of ANTI-FRICTION BEARINGS to ROLL NECKS OF STEEL ROLLING MILLS of THE U. S. A.

HOT SHEET, STRIP, PLATE AND SKELP MILLS

MILL	TYPE	NO. OF STANDS	ROLL DATA: WORK ROLL	ROLL DATA: BACKING ROLL	ROLL DATA: BODY LENGTHS	WHERE OPERATING	POSITION OF BEARING	BEARING NUMBER	BEARING MFG.	YEAR INSTALLED
Hot Strip	4-High	4	18"	37"	38"	Allegheny Steel Company, Brackenridge, Pa.	Backing Rolls Work Rolls	525185-525321 275106-275160-61	Timken	1932
Hot Strip	4-High	3	16"	38"	48"	American Rolling Mill Company, Butler, Pa.	Backing Rolls	480181-480340	Timken	1929-32-33
Hot Strip	4-High	1	16"	38"	48"		Work Rolls	EE-275109-275155	Timken	1934
Hot Strip	4-High		16"	38"	48"		Backing Roll		Bantam	1933
Hot Strip	4-High	4	18"	40"	58"	American Rolling Mill Company, Middletown, Ohio	Backing Rolls	327221-327355-56	Timken	1929
		1	18"	40"	58"		Work Rolls Thrust End	275106-275160-61	Timken	1931
			18"	40"	58"		1-Backing Roll Work Rolls		Bantam	1934
Hot Strip	4-High	5	16"	34"	41"	American Sheet and Tin Plate Company, Gary, Indiana.	Backing Rolls Work Rolls Driven End Opposite End	425178-79 425298-99 89108-89150-51 EE-126096-126150	Timken	1930 1932-33
							3-Backing Rolls	18"x30"x20¾"	Bantam	1933-34
Hot Strip	4-High	7	21"	46"	56"	Ford Motor Company, Detroit, Michigan.	Backing Rolls Work Rolls	EE-424257-424405-6 EE-133136-133180-1	Timken	1934
		1	21"	46"	56"		Edger		Bantam	1934
Hot Strip	4-High	6	18"	37"	38"	Great Lakes Steel Corp., Ecorse, Michigan.	Backing Rolls Work Rolls	525182-525320 275106-275160-61	Timken	1930
Continuous		6	24"	52"	96"	Illinois Steel Company,	Backing Rolls	690296-690465-66	Timken	1931
Plate Strip	4-High	1	24"	52"	96"	South Chicago, Illinois.	Vertical Edger		Bantam	1931
Hot Strip	4-High	1	36"	49"	96"	Inland Steel Company, Indiana Harbor, Indiana.	Backing Rolls Backing Rolls	628285-628465 627260-627435	Timken	1932
		9	25"	49"	76"		Work Rolls	234157-234215-16		
Hot Strip	4-High	2	11"	22"	22¾"	Laclede Steel Company, Alton, Illinois.	Backing Rolls	551000-551700-01	Timken	1927
							Backing Rolls	CS-31077-CS-31031	Rollway	1928
Hot Strip	2-High	1	21½"		20"	McLouth Steel Corporation, Detroit, Michigan.	Roll Necks Roll Necks Thrust End	6481 6482	Messinger	1934
Continuous Skelp Mill	4-High		13"	26"	20"	National Tube Company, McKeesport, Pa.	Backing Rolls	1-26315	SKF	
Hot Strip	4-High	5	20"	45"	72"	Otis Steel Company, Cleveland, Ohio.	Backing Rolls Work Rolls Thrust End	527236-37-527380-81 129121-129172-73	Timken	1932
Hot Strip	4-High	5	16"	32"	42"	Republic Steel Corporation, Warren, Ohio.	Backing Rolls Work Rolls		Bantam	1930
Hot Strip	4-High	4	15"	32"	24"	Sharon Steel Hoop Company, Sharon, Pa.	Backing Rolls Work Rolls	726181-726287 9975-9920	Timken	1932
Hot Strip	3-High	1	12"	7" Baby Roll	14"	Stanley Works, Bridgeport, Conn.	Baby Roll	74539-74850	Timken	1932

HOT SHEET, STRIP, PLATE AND SKELP MILLS (Continued)

MILL	TYPE	NO. OF STANDS	ROLL DATA WORK ROLL	ROLL DATA BACKING ROLL	ROLL DATA BODY LENGTHS	WHERE OPERATING	POSITION OF BEARING	BEARING NUMBER	BEARING MFG.	YEAR INSTALLED
Hot Strip	2-High	2	10½"		18"	Washburn Wire Company, Phillipsdale, R. I.	Caster Rolls on Work Roll Necks	840762-842200	Timken	1929
Hot Strip	Edgers	3					Vertical Rolls Upper and Lower	(2) 95500-95925	Timken	1934
Hot Strip	4-High	3	21"	44"	60"	Wheeling Steel Corporation, Steubenville, Ohio.	Backing Rolls Work Rolls	662301-663550-51 231401-232025	Timken	1928
		6	18"	44"	60"		Backing Rolls Work Rolls	662301-663550-51 111201-111700		
Hot Sheet	3-High	1	20"	32"	48"	Youngstown Sheet & Tube Co., Youngstown, Ohio.	Middle Roll	EE-291203-291750	Timken	1933
Hot Strip	4-High	1	22½"	44"	72"	Youngstown Sheet & Tube Co., Indiana Harbor, Indiana.	Work Rolls	EE-161403-161900-1	Timken	1934
							Backing Rolls	2467-2	Messinger	1926
							Backing Rolls Thrust End	2468-1		

COLD SHEET, STRIP AND TIN PLATE MILLS

MILL	TYPE	NO. OF STANDS	ROLL DATA WORK ROLL	ROLL DATA BACKING ROLL	ROLL DATA BODY LENGTHS	WHERE OPERATING	POSITION OF BEARING	BEARING NUMBER	BEARING MFG.	YEAR INSTALLED
Cold Strip	4-High	1	5½"	19"	18"	Acme Steel Company, Riverdale, Ill.	Backing Rolls	551000-551700-01	Timken	1930
Cold Strip	4-High		5½"	19"	18"		Work Rolls		Rollway	1928
Cold Strip	4-High		8½"	25"	22"		Work Rolls			
Cold Strip	4-High		12"	25"	22"		Thrust End		Bantam	1934
Cold Strip	4-High	4	12"	30"	50"	Allegheny Steel Company, Brackenridge, Pa.	Backing Rolls	551700-572650-51	Timken	1927
*Cold Strip	4-High	1	2¼"	20"	7½"	Allegheny Steel Company, West Leechburg, Pa.	Backing Rolls	2887-2	Messinger	1928
*Cold Strip	4-High	1	2¼"	20"	7½"		Backing Rolls	4146	Messinger	1930
*Cold Strip	4-High	1	2¼"	20"	7½"		Backing Rolls	4146	Messinger	1930
*Cold Strip	4-High	1	3"	24"	20"		Backing Rolls	3592-2	Messinger	1930
*Cold Strip	4-High	1	4"	26"	26"		Backing Rolls	4146-2	Messinger	1930
Cold Strip	4-High	1	14"	34"	58"	American Rolling Mill Company, Ashland, Kentucky.	Backing Rolls Top	671799-672873-74	Timken	1929
		5	14"	34"	58"		Backing Rolls Bottom	425178-79-425298-99	Timken	1931-33-34
Cold Strip	4-High	7	14"	30"	42"	American Rolling Mill Company, Butler, Pa.	Backing Rolls	EE-924172-924269	Timken	1933
								571700-572650-51	Timken	1926
			14"	30"	42"		Backing Rolls		Bantam	1933
			14"	30"	42"		Work Rolls	CS-31064	Rollway	1928
Cold Sheet	2-High	1	26"		58"		Roll Necks	911601-912400-01	Timken	1929-31
Cold Strip	4-High	1	16"	46"	42"	American Sheet and Tin Plate Company, Gary, Indiana.	Backing Rolls	629256-629405-06	Timken	1931
							Work Rolls 2 per position	93801-93125		
Planishing	4-High	1	13"	27"	42"		Backing Rolls Work Rolls	EE-321146-321245 94704-94113	Timken	1933
Reversing Cold Mill	4-High	1	20½"	56"	84"		Backing Rolls Work Rolls	EE-727302-727511 EE-129121-129172-73	Timken	1933
Reversing Cold Mill	4-High	1	20½"	56"	84"		Backing Rolls Work Rolls	30"x51"x25½" 12"x17¼"x11"	Bantam	1933

*Rolls, Frictionally Driven.

COLD SHEET, STRIP AND TIN PLATE MILLS (Continued)

MILL	TYPE	NO. OF STANDS	ROLL DATA: WORK ROLL	ROLL DATA: BACKING ROLL	ROLL DATA: BODY LENGTHS	WHERE OPERATING	POSITION OF BEARING	BEARING NUMBER	BEARING MFG.	YEAR INSTALLED
Reversing Cold Tin Plate	4-High	1	16"	49"	42"	American Sheet and Tinplate Company, Gary, Indiana	Backing Rolls	EE-428262-428420-21		
							Work Rolls 2 per position	93801-93125	Timken	1933
							Backing Roll	26"x42"x25½"	Bantam	1933
			16½"				Backing Rolls	QUILL		
Cold Strip	4-High	1	20½"	32"	84"		Work Rolls	4-ROW TAPER	Bantam	1934
Cold Mill	2-High	1	24"		44"		Roll Necks	QUILL	Bantam	1933
Cold Sheet	2-High	3	28"		84"		Roll Necks	QUILL	Bantam	1934
Cold Sheet	4-High	1	16"	48"	84"	American Sheet and Tin Plate Company, Farrell, Pa.	Backing Rolls	532296-532445-46	Timken	1930
Cold Sheet	4-High	1	16"	34"	55"	American Sheet and Tin Plate Company, McKeesport, Pa.	Backing Rolls	CS-31042		
							Work Rolls	CS-31041	Rollway	1928
							1-Backing Roll		Bantam	1934
Cold Strip	Cluster Tandem	4	10½"	21½"	32"		Backing Rolls	941200-941950-51	Timken	1927
Cold Strip	4-High Tandem	4	11½"	25"	16"		Backing Rolls	790117-790220		
							Work Rolls 2 per position	82576-82950	Timken	1931
Cold Strip	4-High Tandem	4	13½"	33"	26"		Backing Rolls	123167-123290		
							Work Rolls 2 per position	94700-94113	Timken	1931
Cold Mill	2-High		8⅜"		8"	American Steel and Wire Company, Cleveland, Ohio.	Roll Necks	I-70176-6221	SKF	
Cold Mill	2-High		10⅝"		10¼"		Roll Necks	I-70177-6228-x	SKF	
Cold Mill	2-High		10⅝"		18"		Roll Necks	I-70177-6228-x	SKF	
Cold Mill	2-High		10⅝"		18½"		Roll Necks	7813-6228x376	SKF	
Cold Mill	2-High		13"		24"		Roll Necks	I-70192-6234x	SKF	
Cold Mill	2-High		16½"		24"		Roll Necks	I-70191-I-70193	SKF	
Cold Strip	2-High		8"		8"		Roll Necks		Bantam	1932
Cold Strip	2-High		10"		10"		Roll Necks		Bantam	1932
Cold Strip	2-High		16"		24"		Roll Necks		Bantam	1932
Cold Strip	2-High	1	18"		32"		Roll Necks 2 per position	(2) 251000-251575	Timken	1927
							Roll Necks 2 per position	2-ROW TAPER	Bantam	1934
*Cold Strip	4-High	1	2¼"	20"	7½"		Backing Rolls	4146	Messinger	1930
*Cold Strip	4-High	1	2¼"	20"	7½"	American Steel and Wire Company, Worcester, Mass.	Backing Rolls	4146	Messinger	1930
Cold Mills	2-High	21	8"		8"		Roll Necks	(2) 71450-71750	Timken	1933-34
Cold Mill	Special		14½"		10"	Athenia Steel Company, Clifton, N. J.	Roll Necks	22332	SKF	
Cold Mill	Special		6¾"		4¾"		Roll Necks	22315	SKF	
*Cold Strip	4-High	1	3"	24"	18"	Bethlehem Steel Company, Sparrows Point, Md.	Backing Rolls	MF 5319	Rollway	1929
Cold Strip	Cluster	1	7"	14"	24"	E. W. Bliss Company, Salem, Ohio.	Backing Rolls	210750-211300-01	Timken	1929
Cold Strip	2-High		8"		12"	Bopp Steel Corporation, Detroit, Michigan.	Top Roll	QUILL	Bantam	1934

*Rolls, Frictionally Driven.

COLD SHEET, STRIP AND TIN PLATE MILLS (Continued)

MILL	TYPE	NO. OF STANDS	ROLL DATA WORK ROLL	ROLL DATA BACKING ROLL	ROLL DATA BODY LENGTHS	WHERE OPERATING	POSITION OF BEARING	BEARING NUMBER	BEARING MFG.	YEAR INSTALLED
*Cold Strip	4-High	1	2¼"	20"	7½"	Crucible Steel Company, Jersey City, N. J.	Backing Rolls	MF 5319	Rollway	1929
*Cold Strip	4-High	1	2¼"	20"	7½"		Backing Rolls	MF 5319	Rollway	1929
*Cold Strip	4-High	1	3½"	19"	7½"		Backing Rolls	6510	Messinger	1934
Cold Strip	3-High	1	3¼"	9"	9-13/16"	Driver Harris Co., Harrison, N. J.	Top and Bottom Roll Necks	(2) 938-932	Timken	1933-34
Cold Strip	3-High	1	3-7/16"	9⅛"	9-3/16"		Backing Rolls	(2) 580-572	Timken	1934
Cold Strip	4-High	1	3"	6½"	3"		Top and Bottom Roll Necks	(2)71450-71750	Timken	1934
Cold Strip	2-High	2	8"		10"	Eastern Rolling Mill Co., Baltimore, Md.	Backing Rolls	EE-662304-663550-51	Timken	1933
Cold Sheet	4-High	1	16"	44"	84"	Eastern Tool & Stamping Co., Saugus, Mass.	Roll Necks	(2) 759-752	Timken	1933
Cold Mill	2-High	1	8"		8"	Edison Storage Battery Co., East Orange, N. J.	Backing Rolls	4146	Messinger	1934
*Cold Strip	4-High	1	2¼"	20"	7½"	Elliott Brothers Co., New Castle, Pa.	Backing Rolls	3358-1	Messinger	1934
*Cold Strip	4-High	1	3"	24"	18"	Follansbee Brothers Co., Follansbee, W. Va.	Backing Rolls	3975-2	Messinger	1934
*Cold Strip	4-High	1	5"	34"	38"	Ford Motor Company, Detroit, Michigan.	Backing Rolls Work Rolls	EE-424257-424405-6 EE-221028-221575-6	Timken	1934
Cold Strip	4-High	3	18"	46"	56"	Greer Steel Company, Dover, Ohio.	Backing Rolls Work Rolls	EE-321146-321245 (2) 82576-82950	Timken	1933-34
Cold Strip	4-High	2	12"	28"	30"		Roll Necks	EE-129121-129172-3	Timken	1934
Cold Strip	2-High	1	20"		28"	Improved Seamless Wire Co., Providence, R. I.	Roll Necks	(2) 368-362	Timken	1934
Cold Mill	2-High Tandem	6	4"		2"	Inland Steel Company, Indiana Harbor, Indiana.	Backing Rolls Work Rolls	3971-1 6268-2	Messinger	1933
*Cold Strip	4-High	1	8"	34"	38"		1-Backing Roll		Bantam	1934
Cold Strip	4-High	1	20"	44"	72"		Roll Necks	321146-321245	Timken	1932
Cold Mill	2-High	2	27"		48"		Backing Rolls	EE-525185-525321	Timken	1933
Planishing	4-High	2	18"	39"	42"	International Nickel Co., Huntington, W. Va.	Backing Rolls	971352-972100-02	Timken	1930-31
Cold Strip	Cluster	2	14"	24"	42"		Backing Rolls	2887-2	Messinger	1928
*Cold Strip	4-High	1	2¼"	20"	7½"	Jones & Laughlin Steel Corp., Aliquippa, Pa.	Backing Rolls Work Rolls	EE-528301-528480-81 (2) EE-93801-93125	Timken	1933
Reversing Cold Tin Plate	4-High	1	16½"	53"	42"	Newman Crosby Co., Pawtucket, R. I.	Backing Rolls Work Rolls	(2) EE-420800-421437 (2) 469-453-x	Timken	1934
Cold Strip	4-High	1	5¼"	16"	12"	Otis Steel Company, Cleveland, Ohio.	Backing Rolls Work Rolls Thrust End	532297-532445-46 129121-129172-73	Timken	1932
Cold Strip	4-High	2	20½"	52"	72"	Republic Steel Corporation, Canton, Ohio.	Backing Rolls	261600-262500-01	Timken	1927
Cold Strip	Cluster	1	14"	27"	54"		Backing Rolls		Bantam	1934
Cold Strip	Cluster	1	14"	27"	54"		Work Rolls	CS 31099	Rollway	1929
Cold Strip	4-High	1				Republic Steel Corporation, Massillon, Ohio.	Backing Rolls Work Rolls		Bantam	1932
Stainless Cold Strip	4-High	2	15"	32"	20"		Backing Rolls	941200-941950-51	Timken	1928
Cold Strip	4-High	1	9½"	24"	20"	Republic Steel Corporation, Warren, Ohio.	Backing Rolls Work Rolls		Bantam	1931
Cold Strip	4-High		16"	32"	20"		Backing Rolls	EE-924172-924289	Timken	1934
Cold Strip	4-High	1	10¼"	32"	38"		Backing Rolls	3358-1	Messinger	1929
*Cold Strip	4-High	1	3"	24"	18"					

*Rolls, Frictionally Driven.

COLD SHEET, STRIP AND TIN PLATE MILLS (Continued)

MILL	TYPE	NO. OF STANDS	ROLL DATA: WORK ROLL	ROLL DATA: BACKING ROLL	ROLL DATA: BODY LENGTHS	WHERE OPERATING	POSITION OF BEARING	BEARING NUMBER	BEARING MFG.	YEAR INSTALLED
							Backing Rolls	4-ROW TAPER	Bantam	1934
Cold Strip	4-High	1	11½"	25"	16"	Rotary Electric Steel Co., Detroit, Michigan.	Work Rolls	(2) 82576-82950	Timken	1934
Cold Sheet	2-High	2	12"		10"		Roll Necks		Bantam	1934
Cold Mill	Tandem Cluster	4	10½"	21"	26"		Backing Rolls	941200-941950-51	Timken	1928
Cold Mill	Cluster	1	8½"	16½"	26"		Backing Rolls	221025-221575-76	Timken	1928
Cold Mill	Tandem Cluster	3	8½"	16½"	18½"	Sharon Steel Hoop Company, Sharon, Pa.	Backing Rolls	221025-221575-76	Timken	1928
Cold Finishing	2-High	1	18"		26"		Roll Necks	221025-221575-76	Timken	1928
Cold Strip	2-High		10½"		18"		Roll Necks	CS-31046	Rollway	1928
Narrow Strip	2-High		8½"				Roll Necks	CS-31063	Rollway	1928
Narrow Strip	2-High		10½"		10"		Roll Necks	CS-31046	Rollway	1928
*Cold Strip	4-High	1	2¼"	20"	7½"	Signode Steel Strapping Co., Chicago, Ill.	Backing Rolls	4146	Messinger	1930
Cold Strip	2-High	1	14"		14"	Stanley Works, New Britain, Conn.	Roll Necks	280700-281200-01	Timken	1930
Cold Strip	2-High	1	4"		4"		Roll Necks	QUILL	Bantam	1934
							Work Rolls	CS-31064	Rollway	1928
Cold Strip	4-High	1	7"	19"	24"		Backing Rolls	551000-551700-01	Timken	1930
*Cold Strip	4-High	1	3"	24"	20"		Backing Rolls	3592-2	Messinger	1933
Cold Mill	2-High	1	16"		24"	Thomas Steel Company, Warren, Ohio.	Roll Necks	420800-421450-51	Timken	1930
Cold Mill	2-High	1	10"		16"		Roll Necks	95499-95925	Timken	1930
Cold Strip	4-High	3	4½"	16"	12"		Backing Rolls	780702-781400	Timken	1929-31-32
Cold Strip	4-High	2	4½"	16"	12"		Work Rolls 2 per position	3780-3720	Timken	1931-32
Cold Strip	Cluster	1	4½"	9½"	8"	Thompson Wire Company, Boston, Mass.	Backing Rolls	74512-74850	Timken	1934
Cold Strip	4-High	1	7"	25"	16"	Wallingford Steel Company, Wallingford, Conn.	Work Rolls Thrust End 2 per position	6461-6420	Timken	1932
Cold Mill	2-High	1	14"		14"		Roll Necks	EE-210752-211300-01	Timken	1934
Cold Mill	3-High	1	7"	14"	14"		Middle Roll	579-D-572	Timken	1933
Cold Mill	2-High	1	14"		14"		Roll Necks	EE-210752-211300-01	Timken	1932
Cold Mill	2-High	1	8"		8"		Roll Necks	71426-71750	Timken	1934
Cold Mill	2-High Tandem	6	4"		2"	Waterbury-Farrell Company, Waterbury, Conn.	Roll Necks	(2) 368-362	Timken	1934
*Cold Strip	4-High	1	5"	32"	38"		Backing Rolls	3367-2	Messinger	1930
*Cold Strip	4-High	1	3"	24"	20"		Backing Rolls	3592-2	Messinger	1932
*Cold Strip	4-High	1	4"	26"	28"		Backing Rolls	4166-2	Messinger	1933
Cold Strip	4-High	5	14"	32"	48"	Weirton Steel Company, Weirton, W. Va.	Work Rolls	EE-9977-9920	Timken	1933-34
		1	18"	42"	38"		Backing Rolls	EE-725212-725356	Timken	1934
Cold Strip	4-High	4	18"	42"	38"		Work Rolls	EE-324103-324160	Timken	1933
Cold Strip	4-High	1	2"	11"	4"	Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.	Backing Rolls	865-854	Timken	1930
Cold Strip	2-High	2	27"		48"	Wheeling Steel Corporation, Steubenville, Ohio.	Roll Necks	321146-321245	Timken	1930

*Rolls, Frictionally Driven.

COLD SHEET, STRIP AND TIN PLATE MILLS (Continued)

MILL	TYPE	NO. OF STANDS	ROLL DATA: WORK ROLL	ROLL DATA: BACKING ROLL	ROLL DATA: BODY LENGTHS	WHERE OPERATING	POSITION OF BEARING	BEARING NUMBER	BEARING MFG.	YEAR INSTALLED
Cold Strip	4-High	3	18"	30"	32"	Wheeling Steel Corporation, Yorkville, Ohio.	Backing Rolls Work Rolls	328172-328269 420804-421450	Timken	1930
Cold Strip	4-High	1	18"	39"	42"		Backing Rolls	EE-525185-525321	Timken	1934
Cold Strip	2-High	5	27"		48"		Roll Necks	321146-321245	Timken	1930
Cold Strip	2-High	1	27"		48"		1-Roll Neck	QUILL	Bantam	1934

ROD, RAIL, STRUCTURAL AND MERCHANT MILLS

Rod Mills	2-High		8"			American Steel & Wire Co., Cleveland, Ohio.	Roll Necks	CS-31036	Rollway	1928
Nut Stock	2-High		10"				Roll Necks	CS-31047	Rollway	1928
Beam Mill	Side Roll	1				Bethlehem Steel Company, Bethlehem, Pa.	Vertical Flange Rolls	515060-515237	Timken	1930
Rail and Structural Mill	Side Roll	1				Bethlehem Steel Company, Steelton, Pa.	Side Rolls 2 per position	EE-117063-117148	Timken	1928
Rod Mill	2-High	1				Canadian Tube & Steel Products, Ltd., Montreal.	Roll Necks	73550-73875-86	Timken	1931
Rod Mill	2-High		9¾"		10"		Roll Necks	1-28805-1-37603-1-34105-K	SKF	
Beam Mill	Universal	3				Carnegie Steel Company, Munhall, Pa.	Vertical Rolls	141250-142550-51 141250-142651-52	Timken	1927-31
Precision Rod Mill	Vertical	1				Carnegie Steel Company, Youngstown, Ohio.	Roll Necks	93825-93125	Timken	1934
Bar Mill	2-High	4	21"			Great Lakes Steel Corporation, Ecorse, Mich.	Roll Necks	722111-722185-86	Timken	1931
Bar Mill	2-High	6	18"				Roll Necks	551027-551662-63	Timken	1931
Bar Mill	3-High	2	18"				Roll Necks (2 Rolls per Stand)	551027-551662-63	Timken	1931
Beam Mill	Universal	3				Illinois Steel Company, South Chicago, Ill.	Vertical Rolls	141250-142651-142652	Timken	1931
Structural Mill Feed and Back Stands	2-High	2				Kalman Steel Company, Buffalo, N. Y.	Roll Necks Left Roll Necks Right	(2) 74537-74850 (2) 71450-71750		
Structural Mill Main Slitting Stand	2-High	1					Roll Necks Upper and Lower Left	420800-421450	Timken	1928
							Roll Necks Upper Right	93800-93125 2 per position		
							Roll Necks Lower Right	99550-99100 2 per position		
Cotter Pin Mill	2-High	1				Page Steel & Wire Company, Monessen, Pa.	Top Roll Necks Roll Necks	581-D-572 687-692	Timken Timken	1934 1933
Bar Mill	2-High	6	4"		4"	Rotary Electric Steel Company, Detroit, Mich.	Roll Necks	QUILL	Bantam	1934
Bar Mill	2-High	4	5"		4"		Roll Necks	QUILL	Bantam	1934
Billet Mill	3-High	2	28"			Timken Steel & Tube Company, Canton, Ohio.	Roll Necks	911601-912400-01		
Billet Mills	3-High	2	22"				Roll Necks	291200-291750-51		
Merchant Mills	2-High	6	16"		36"		Roll Necks Drive Side	130900-131400-01		
							Roll Necks Opposite Side	130850-130900 131400-131401		
Merchant Mills	2-High	3	18"		36"		Roll Necks Drive Side	221025-221575-76	Timken	1928
							Roll Necks Opposite Side	220975-221025 221575-221576		
Merchant Mill	3-High	1	16"		36"		Roll Necks Drive Side	130900-131400-01		
							Roll Necks Opposite Side	130850-130900 131400-131401		
Vertical Mill	2-High	1	12"				Vertical Necks	73550-73875-76		

SEAMLESS, LAP, BUTT AND ELECTRIC WELD TUBE MILLS

MILL	TYPE	NO. OF STANDS	ROLL DATA: WORK ROLL	ROLL DATA: BACKING ROLL	ROLL DATA: BODY LENGTHS	WHERE OPERATING	POSITION OF BEARINGS	BEARING NUMBER	BEARING MFG.	YEAR INSTALLED
#1 Piercing Mill		1				Babcock & Wilcox Tube Co., Beaver Falls, Pa.	Main Rolls Piercing End	181452-182350-51	Timken	1931
							Main Rolls Opposite End	390095-390200		
#3 Disc Type Piercing Mill		1					Cross Rolls (2) Front	EE-420801-421451	Timken	1934
							Cross Rolls (2) Rear	(2) EE-516050-516122		
							Disc Rolls (2) Right Hand	(2) 99600-99100		
							Disc Rolls (2) Left Hand	(2) 71450-71750		
Sizing Mills		5					Roll Necks	130900-131400	Timken	1931
Tube Elongator		1	21"		36"		Cross Roll Necks	130900-131400		
Reeler		2					Roll Necks	550988-551700-01		
Reducing Mill	Special						Roll Necks	1-70302	SKF	
Lap Weld Tube Mill		1	6"		16"	Bethlehem Steel Company, Sparrows Point, Md.	Cross Roll Necks	99587-99100 4 per position	Timken	1927
							Lower Cross Roll Necks	710900-711600 2 per position		
							Upper Cross Roll Necks	710900-711600 2 per position		
Tube Welding Machine		3				Fretz Moon Tube Co., Butler, Pa.	Roll Shafts	74500-74850 2 per position	Timken	1927
							Inner Vertical Roll Shaft, Top and Bottom	861-854 1 per position		
							Outer Vertical Roll Shaft, Top	861-854 1 per position		
½" Butt Tube Welding Machine		3					Vertical Roll Upper	558-552-A 2 Bearings	Timken	1932
							Vertical Roll Lower	3982-3920 2 Bearings		
							Horizontal Roll Left Hand	558-552-A 2 Bearings		
							Horizontal Roll Right Hand	3982-3920 2 Bearings		
Piercing Mill			27"			Globe Steel Tubes Company, Milwaukee, Wisc.	Journal	22344-X	SKF	
Reeling Mill			28"				Journal	22338	SKF	
Reeling Mill			24"				Journal	22336	SKF	
Gauging Mill			12"		6"		Journal	1-26303	SKF	
Tube Sizing Mill		23 Rolls	4½"			Jones & Laughlin Steel Corp., Aliquippa, Pa.	Roll Necks	462-452-D	Timken	1933-34
Push Bench Sizing Mill	Vertical Rolls	2					Roll Necks 2 per position	99587-99100	Timken	1931
Tube Sizing Mill		2	4½"				Mandrel, Right Hand Left Hand	2-R-462-452-D 2-R-567-563-D	Timken	1934
Reducing Mill	Special						Roll Shaft	W.U.L.-32211	SKF	

SEAMLESS, LAP, BUTT AND ELECTRIC WELD TUBE MILLS (Continued)

MILL	TYPE	NO. OF STANDS	ROLL DATA: WORK ROLL	ROLL DATA: BACKING ROLL	ROLL DATA: BODY LENGTHS	WHERE OPERATING	POSITION OF BEARINGS	BEARING NUMBER	BEARING MFG.	YEAR INSTALLED
Butt Weld Sizing Mill	2-High	1				Laclede Tube Company, Alton, Ill.	Overhung Sizing Roll	861-854	Timken	1930
Piercing Mill			24"			National Tube Company, Ellwood City, Pa.	Main Rolls	8"x16"x10"		
Hot Elongator			24"				Guide Discs	5"x10-3/16"x3¼" 2 per position	Bantam	1933
Reeling Mill			36"			National Tube Company, Gary, Indiana.	Journal	22352X	SKF	
#4 Lap Weld		1					Roll Necks	280700-281200-01	Timken	1928
Hot Elongator		1	24"		43"	Pittsburgh Steel Company, Allenport, Pa.	Roll Necks	EE-721092-721162	Timken	1934
Piercing Mill		1	34"			Timken Steel & Tube Co. Canton, Ohio.	Driven End	941202-941950	Timken	1929
							Opposite End	941102-941950		
Return Mill		1	26"				Roll Necks	231401-232025-26		1929
Reelers		2	26"				Roll Necks	280701-281200-01		1929
Reducing Mills		33	12"				Roll Necks	99587-99100 2 per position		1927
Piercing Mill		1	36"				Driven End	941202-941950	Timken	1929
							Opposite End	941102-941950		1929
Return Mill		1	26"				Roll Necks	231401-232025-26	Timken	1929
Reelers		2	30"				Roll Necks	550988-551700-01		1929
Reducing Mills		42	16"				Roll Necks	280700-281200		1929
Butt Weld Tube Sizing Mill	2-High	1				Wheatland Tube Company, Sharon, Pa.	Roll Necks Right Hand	94650-94113 2 per position		
							Roll Necks Left Hand	95500-95925 2 per position	Timken	1931
Butt Weld Tube Sizing Mill	2-High	2				Youngstown Sheet & Tube Co., Indiana Harbor, Indiana.	Roll Necks Left Hand	95500-95925 2 per position	Timken	1929
							Roll Necks Right Hand	94650-94113 2 per position		
Electric Weld Tube Forming Mill	2-High	15	24"				Roll Necks	291201-291750 2 per position		
							Vertical Sizing Roll, Top	99587-99100	Timken	1930
							Vertical Sizing Roll, Bottom	99600-99100	Timken	1930
							Horizontal Sizing Rolls	181451-182350		
							Small Sizing Rolls	462-453-A		
Electric Weld Straightening		1	24"			Youngstown Sheet & Tube Co., Youngstown, Ohio.	Straightening Rolls	430900-431575 2 per position	Timken	1930
Electric Weld Tube Forming Mill		3					Forming Rolls	(2) 99550-99100	Timken	1934
							Guide Rolls Top Right and Left Hand	755-752		
							Guide Rolls Bottom Left and Right Hand	99600-99100		
							Welding Rolls Top	99600-99100		
							Welding Rolls Bottom	EE-526130-526190		

ITEMS OF INTEREST

PERSONNEL CHANGES

Howard M. Wilson, formerly vice president and treasurer of Taylor-Wilson Mfg. Co., McKees Rocks, Pa., manufacturer of pipe and tubemaking machinery, was recently elected president of the company. Mr. Wilson has been with the concern for 11 years.

O. A. Christiansen, formerly assistant secretary and treasurer of the company, has been elected secretary and treasurer.

▲

Russell W. Chew, formerly assistant engineer at the Pottstown, Pa., plant of McClintic-Marshall Corporation, has been appointed resident engineer at the Rankin works, Pittsburgh, for the company, succeeding J. J. Ashton, resigned.

▲

George A. Higgins has been appointed assistant manager of sales in the Pittsburgh district sales office of Carnegie Steel Company.

▲

Joseph G. Armstrong, Jr., has been named assistant to the manager of sales in the Pittsburgh district sales office of Carnegie Steel Company.

▲

G. N. Harman has been elected a vice president of Continental Roll & Steel Foundry Company, East Chicago, Ind., to be located at the company's Pittsburgh division. He formerly was Chicago representative of United Engineering & Foundry Company, Pittsburgh, and has been in the sales department of the Continental company since 1932.

▲

J. T. Ryan, formerly sales engineer of the Pittsburgh branch of the Century Electric Company, St. Louis, Mo., has recently been appointed district manager. Mr. Ryan, an associate member of the A. I. & S. E. E., has been active with the Pittsburgh branch of the Century Electric Company for the past fifteen years.

▲

U. G. Miller, Frank Garratt and J. O. Rinek have been elected vice presidents of the Universal Steel Company, Bridgeville, Pa.

▲

Lee Landon, assistant manager of the Elwood, Ind., plant of the American Sheet & Tin Plate Company, has been transferred to the Gary tin plate plant of the same company, effective August 16. In his new position he will be assistant to Thomas O'Brien, formerly of the Elwood plant. Mr. Landon became affiliated with the Elwood plant in 1906 as resident engineer. He removed to the Wheeling district for a few years and then returned to Elwood. Five years ago he was made manager of the New Kensington, Pa., plant, which was closed the early part of 1932, when he returned again to Elwood.

WITH THE MANUFACTURERS

"Farval in Steel" is the title of a recently-issued booklet describing the Farval Method of lubricating steel plant machinery.

From the viewpoint of operating officials, especial interest lies in the fact that the illustrations show typical modern steel plant equipment, so arranged from page to page that the succession of pictures follows the course of production in a typical mill.

The correct methods of lubricating heavy equipment by the Farval System are fully explained, both in pictures and in text. A comprehensive flow sheet shows the vital points of lubrication in all principal machines used in steel production.

Methods of lubricating heavy equipment in other industries are also suggested.

▲

A new catalog on Straight Roller Radial and Roller Thrust Bearings has just been published by the Bantam Ball Bearing Company of South Bend, Ind.

A concise treatment of various types of Straight Roller Bearings both radial and thrust including Mill type bearings, Heavy Thrust Bearings, Crane Hook Bearings, Radial Roller Bearings and extra light Radial Bearings is given.

A complete list of dimensions and capacities in both inch and metric sizes is given for Radial Roller Bearings as well as the other types of bearings described in the catalog. A table of speed factors together with general modification factors as well as a table on tolerances and fitting practices are included.

The catalog is well illustrated with half-tone reproductions of the various types of bearings covered, in addition, a number of line drawings are used to show various bearing mountings.

In addition to the section on Straight Roller Radial and Roller Thrust Bearings, the following sections have recently been issued: Quill Roller Bearings, Printing Press Bearings, Tapered Roller Bearings, the Engineering Section of the general catalog. Sections on Ball Thrust and Ball Radial Bearings will be released soon.

▲

The Poole Foundry & Machine Company, Baltimore, Md., announce that they are now sole owners of all domestic and foreign patents covering and pertaining to the Poole (all metal-gear lubricated) Flexible Shaft Coupling.

▲

The General Electric Company, Schenectady, are distributing their new Catalog GEA-602D on Electric Instruments. This new 170 page catalog contains information on standard lines of switchboard, portable and laboratory instruments. This catalog supersedes Catalog 602C.

▲

Salem Engineering Company, Salem, Ohio, has been organized by Sam Keener and M. H. Mawhinney, both formerly associated with the Electric Furnace Company, Salem, Ohio. The new company

will engage in consulting engineering, and the designing and building of fuel fired and electric industrial heating furnaces and auxiliary equipment. The company will also engage in the development of patents on equipment of this nature for the steel mills and other industries. Engineering offices and shop facilities have been established and the company is in active operation.

▲

A large lubricating system has been purchased from R. M. Gordon & Company by the United Engineering & Foundry Co., for the new strip mill which they are building for the Ford Motor Company. All of the bearings in this mill, totaling approximately 2200, will be lubricated automatically.

▲

A number of improvements in the G-E Thrustor, a self-contained combination of motor-driven centrifugal pump, oil chamber, and piston that produces a smooth straight-line thrust through a definite length of stroke especially suitable for the operation of clutches, brakes, valves, doors, etc., have been announced by the General Electric Company.

The new line of Thrustors consists of a complete range of standard models providing 10 combinations of thrust and stroke ratings varying from 50 to 3200 pounds thrust and from 2 to 16 inches stroke.

▲

The Roller-Smith Company, 233 Broadway, New York City, announces a new line of instrument and control switches as illustrated and described in Catalog No. 9.

These new switches, designated, Type "R Rotary", are used extensively on switchboards and control panels of all kinds. The instrument switches are used in connection with electrical measuring instruments and the control switches are used for establishing proper connections to air and oil circuit breakers and other equipment of that nature.

Special attention is called to the fact that this new line has been worked out so as to provide a switch for every known requirement. These switches are very sturdy and compact and are as nearly foolproof as it is possible to make apparatus of this kind.

▲

A new line of small A.C. and D.C. solenoid operated brakes is announced by Cutler-Hammer, Inc., Milwaukee, Wis. Three new brake sizes are included with torque ratings ranging from 3 lbs. feet to 75 lbs. feet. These torque ratings are in accordance with NEMA standards, conforming closely to the full load torque ratings of small standard motors.

The brake wheel is relatively large, allowing low total brake shoe pressures, which, distributed over the large brake lining area, results in low unit pressure on the lining and therefore long, even wear of the friction surfaces. The low shoe pressure also results in low stresses on all pins and pivot points, assuring longer wear for these parts, and allows the use of a small operating solenoid which requires less current, thereby affecting a slight saving in operating costs of the brake.

Dimensions of the A.C. and D.C. brakes are interchangeable, so that machine designers can provide standard mounting holes and apply either the A.C. or D.C. brake as needed. Brake shoes use moulded brake lining and provide 180° braking service.

▲

A new booklet on the applications of Monel Metal, Nickel, and Nickel-clad steel has been issued by the Technical Service Department of The International Nickel Company. It has been prepared especially for users of industrial processing equipment.

Besides giving data on the physical and mechanical properties of these materials, the booklet contains considerable miscellaneous information, including instructions on the selection of suitable welding rod and other details on fabrication.

▲

ASSOCIATION NOTES

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS

Officers for Year 1934-35 — Cleveland District Section

The results of the recent election were as follows:
Chairman—C. Clarke Wales.
First Vice Chairman—J. H. Barse.
Second Vice Chairman—G. E. Whittaker.
Secretary—W. W. Spanagel.

▲

Reduced round-trip R. R. rates for the 1934

A. I. & S. E. E. CONVENTION AND IRON AND STEEL EXPOSITION

Cleveland, O., Sept. 18, 19, 20, 1934

(Identification Certificate Plan)

On account of our Annual Convention and Iron and Steel Exposition being held in Cleveland, O., Sept. 18, 19, 20, we have been granted a one and one-third round trip railroad rate (with minimum of $1.00) through use of the Identification Certificate Plan. This low rate applies on round-trip tickets via the same route on both going and returning trips and if a diverse route is used on the return trip there is only a slightly higher tariff applying, however full information can be given you by your local ticket agent who has a complete file of these tariffs, etc. This low rate applies to nearly every railroad of the United States, also to the principal Canadian points.

From most points, tickets will be on sale from Sept. 14th to Sept. 18th for the going trip, however from far distant points the sale starts one day earlier. **These tickets are good for thirty days from date of sale** (including day of sale) and must be validated at the regular ticket office in Cleveland, O., before they can be honored for return passage; this validation begins on Sept. 18, 1934, but the return trip may start from Cleveland on any day within the final limit of the ticket. The return trip must be completed by midnight of the date of the expiration of the ticket.

Only ONE Identification Certificate is needed for each one eligible as this Certificate will also take care of the dependent members of his family, however the Certificate must be presented and surrendered to your ticket agent when you purchase the round-trip ticket at this reduced rate.

In event you desire several Certificates please let us know and we will take care of your requirements.

WHY BUY BUSS SUPER-LAG FUSES?

that's a fair question for you to ask

Here's a quick picture that may give you the answer and show why BUSS Fuses save time and money for the user.

The Super-Lag Feature

BUSS Super-Lag Fuses have a super-long time-lag.

They don't blow as often as old style fuses—they won't pop open on every surge or harmless overload.

They help keep machines running—keep workers on the job—and prevent needless shutdowns.

They give better motor protection—make it possible to fuse nearer to the motor rating—prevent single phasing.

One Piece Links

Insure better contact within the fuse than when several links and washers must be bolted together—needless blows due to heat from poor contact are eliminated—charring of cases is avoided.

Make renewal of large size fuses very simple—save trouble and time.

Fuse Case Design

Few simple parts make renewal quick and easy—faulty renewal is impossible.

Fuses have longer life as they can stand the wear and tear—there's nothing to break or lose.

Heating from poor contact prevented—charring and burning of cases practically eliminated—needless blowing of fuses is avoided—and fuse bills are materially reduced.

Cost Least to Use

Judged by performance—the cheapest and most dependable electrical protection is obtained by using BUSS Fuses.

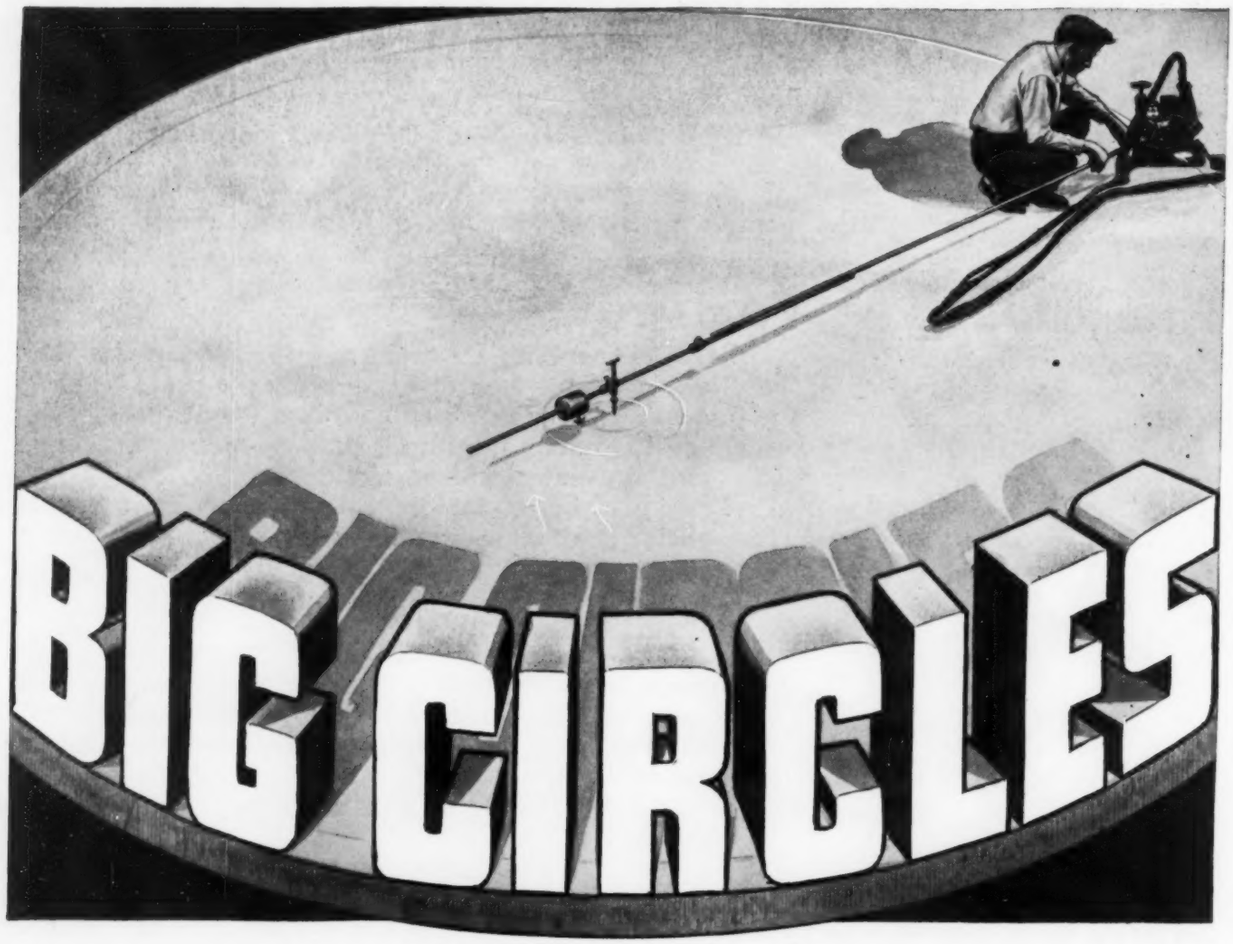
Why not get full data so that you can make your own comparison with other fuses—just drop us a line.

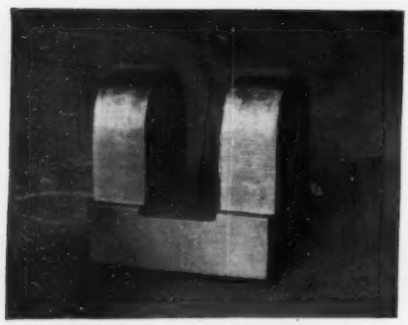
BUSSMANN MANUFACTURING CO., ST. LOUIS, MO.

A Division of the McGraw Electric Company.

BUSS SUPER-LAG FUSES

A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY





Does this difficult flame-cut piece suggest jobs on which you can save and improve with flame-cut steel plate? Let's talk it over.

Here is one of five big plates we rolled and flame-cut for flywheels. Each plate was 4″ thick, 190″ diameter, weighed over 17 tons, and had a flame-cut center hole 26″ in diameter.

Our customer's specification called for plates "free from laminations, over-rolls, deep seams or other defects." All five plates were accepted by the customer on his first inspection.

On our 206″ mill, World's Largest Plate Mill, we can roll plates for flame-cutting to circles as big as 195″ in diameter . . . sometimes greater through special arrangement.

We can also flame-cut many intricate shapes from wider plates and thicker plates than you can obtain elsewhere. May we show you some interesting pictures of intricate flame-cut shapes that are saving money for their users? Write us today.

At the Iron & Steel Exposition, Cleveland Public Auditorium, September 18, 19 and 20, Visit Our Display in Booth No. 106.

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GIVING ASSURANCE OF THE RIGHT EQUIPMENT

To develop furnaces ahead of industry's needs, Surface Combustion maintains a Research and Development Division exceeding by far in activity anything known in the industry.

● In this department creative engineering experts are constantly at work improving and developing new and more advanced methods of heat treating. They are contributing value beyond the furnace. Processes are interpreted into mechanisms for continuous production...where lubrication is impossible...where temperatures prohibit some of the simplest mechanical devices...where atmospheric control is essential.

In these laboratories, furnaces are built and perfected. They are thoroughly tested under actual operating conditions to assure industry of successful results.

Almost every major furnace improvement or heat treating process during the past many years has been pioneered and developed here. During this time much knowledge has been gained from these activities, and much experience has been derived from thousands of installations of SC equipment.

Utilize this experience by consulting these engineers about your own heat treating problems.

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TOLEDO, OHIO Sales and Engineering Service in Principal Cities

Whether for ingot, billet, rod, wire, tube, bar, sheet, or tin plate, we will be glad to help you plan the most modern and efficient equipment to best perform your heating operation. SC Soaking Pits, Slab or Billet Heaters, Pack or Pair Furnaces, Normalizers and Annealing Furnaces are correctly designed, engineered and built for the individual requirement.

This husky Geared Unit

has been running continuously for over 7 years

THE motor is a Crocker-Wheeler slip ring, enclosed pipe ventilated type, 1000 H.P., 60 cycle, 3 phase, 2200 volt machine driving a sheet mill. This is a typical Crocker-Wheeler installation. Rugged, efficient and dependable, Crocker-Wheeler motors perform day in and day out in an industry that is early death to motors that would perform for considerable periods in service less exacting. The Crocker-Wheeler line includes motors, generators, both D.C. and A.C., and motor generator sets in sizes and types for every still mill need.

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A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

Follow through!

GOOD golf is a matter of coordinating mind and muscles. Clubs alone cannot make a successful shot. » » » Likewise it takes skillful application engineering to insure that bearings will deliver the utmost performance that is built into them. » » » For certainty of success use New Departure Ball Bearings and *follow through* by utilizing the skill and experience of New Departure engineers in applying these fine bearings to the job they are to perform. New Departure Mfg. Company, Bristol, Conn. Detroit, Chicago, San Francisco and London.

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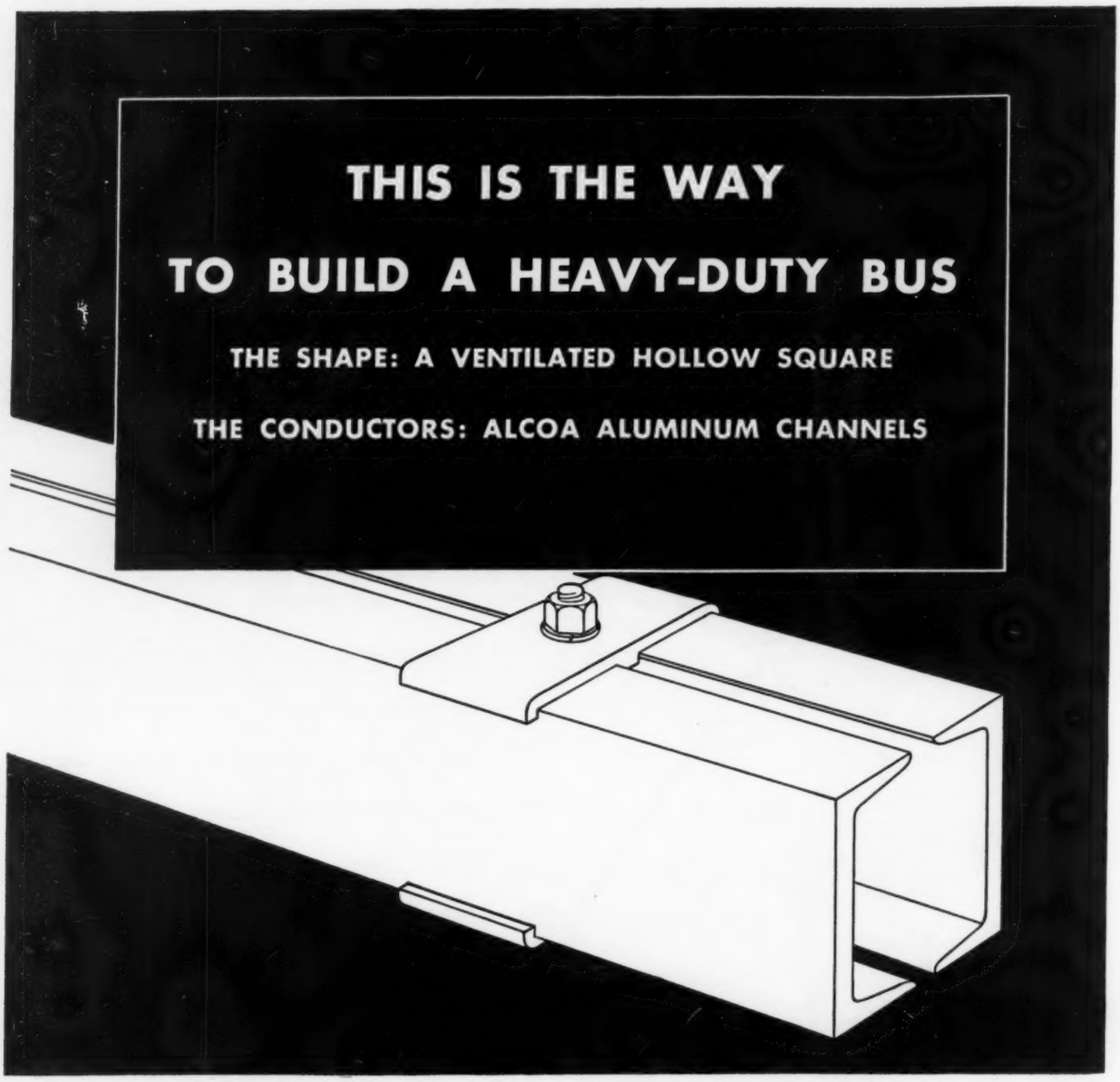
2113

A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY



HERE'S WHY: To hollow-square electrical and thermal efficiency are added the practical advantages inherent in the great strength of this familiar structural shape. And when the shape is of Alcoa Aluminum at least 52% of ordinary conductor weight is saved.

This ideal combination of low weight and great strength permits long runs between supports without sacrificing desirable factors of safety, and requires the use of even fewer of the very economical fittings which have been developed to meet all installation requirements.

Vertical, horizontal, and triangular phase configurations can all be achieved in minimum space, with simple mountings, and very low installation costs. Turns and angles easily made. Joints and tap-offs may be bolted or welded.

Alcoa Aluminum Channels for Busses are particularly designed for alternating currents above 2000 amperes. For lighter loads, for connections to auxiliary busses, Alcoa Aluminum Flats are similarly economical.

For the whole story send for "Channeluminum Electrical Conductors of Alcoa Aluminum."

ALUMINUM COMPANY OF AMERICA
1828 GULF BUILDING, PITTSBURGH

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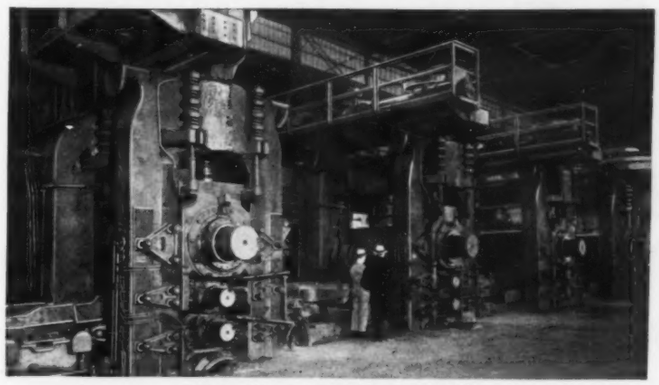
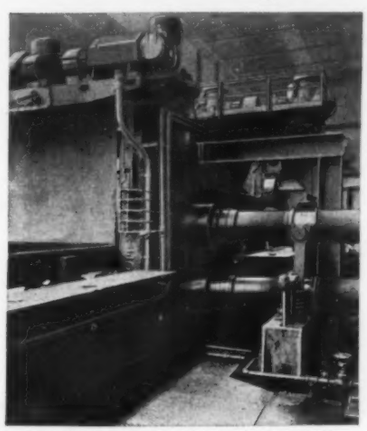
A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

The 4 LARGEST Continuous Strip Mills are all Farval Equipped



"United" 72-in. Hot Strip Mill



"United" 96-in. Plate Strip Mill

"Mesta" 79-in. Hot Strip Mill

"Mesta" 60-in. Hot Strip Mill

THIS preference has been earned over a period of 6 years through the positive and dependable lubrication provided by Farval on more than 100 Strip Mill Stands.

In each of these installations, Farval delivers an exact, measured charge of grease, at high pressure to every bearing. There is never a feast nor a famine, because every bearing always receives the proper amount of lubricant. The frequency may be varied to suit the conditions, but the performance is constant and positive.

Water and scale are kept out of the Roller Bearings by Farval, because the proper amount of grease maintains the full efficiency of the Bearing Seals at all times.

Farval lubricated bearings are thus protected in advance against costly delays and the expense of replacement.

A Farval System can be quickly applied to your existing Mills without interference to operation.

Write for the complete new Farval Steel Bulletin No. 75

THE FARVAL CORPORATION

3278 East 80th Street Cleveland Ohio

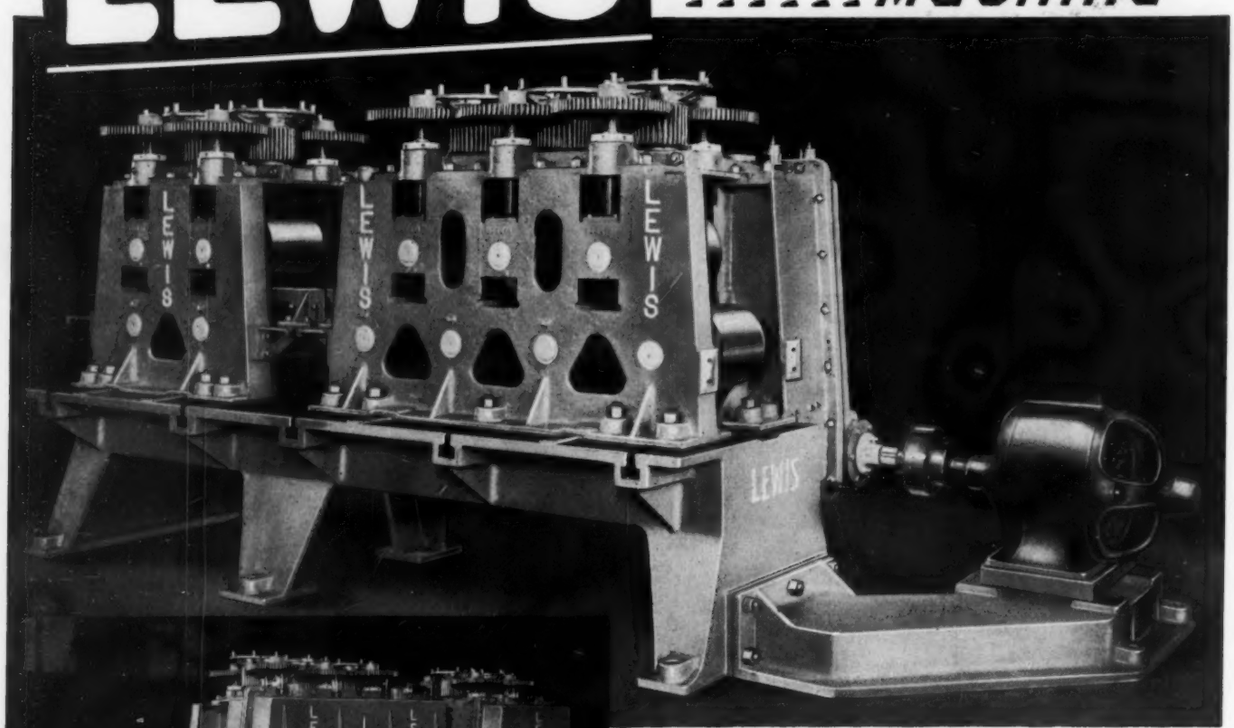
Sales Engineers in Principal Industrial Districts

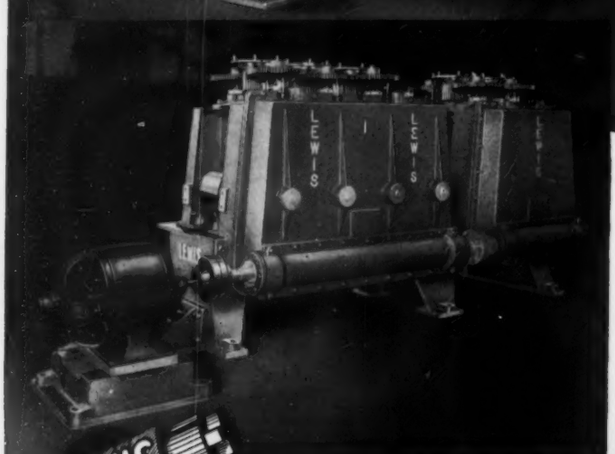
FARVAL

CENTRALIZED SYSTEM OF LUBRICATION

A New Development by LEWIS

Combination... FORMING *and* STRAIGHTENING *.....Machine*





Three operations in one machine . . . . Send for complete information about this remarkable unit.

LEWIS FOUNDRY & MACHINE CO.
PITTSBURGH, PA.

Tabulation of Applications of SKF Anti-friction Bearings to Roll Necks of Rolling Mills

Mill	Type	No. of Stands	Roll Data: Work Roll	Roll Data: Backing Roll	Roll Data: Body Length	Where Built or in Operation	Position of Bearing	Bearing No.	Make of Bearing	Year Instl'd
Hot Sheet, Strip & Plate Mills										
Continuous Strip	2-High	4	11"			Czechoslovakia	Work Rolls	I-28808	SKF	1931
	3-High	1	9"			England	Pinion Stand	I-112406	SKF	1933
Continuous Strip	2-High	2	12"				Work Rolls	I-28808	SKF	1933
Strip	3-High	6	18⅞"	12¼"	18⅞"		Work Rolls	I-28822 I-112405 I-112522 I-112505	SKF	1933
Strip	3-High	5	10¼" 16½"				Work Rolls	I-28818 I-37601	SKF	1929
Strip	Comb. 4-High & 2-High	1	14¼" 7⅞"				Work Rolls	I-28812 I-34110	SKF	1929
Strip	2-High	1	24"				Vertical Stand	I-26305 I-26308	SKF	1931
Strip	2-High	1	24"				Vertical Stand	I-26304 I-26307	SKF	1931
Strip	2-High	1	11¾"				Work Rolls	I-28808	SKF	1931
Strip	2-High	8	11¾"				Work Rolls	I-28808	SKF	1932
Strip	2-High	8					Vertical Stand		SKF	1932
Strip	Double 2-High	5	13¾"				Work Rolls	I-28813	SKF	1932
Strip	Double 2-High	1	13¾"			Germany	Pinion Stand	I-68389	SKF	1932
Strip	2-High	8					Pinion Stand		SKF	1933
Continuous Strip	2-High	7	11¾"				Work Rolls	I-28808	SKF	1933
Strip	Double 2-High	5	13¾"				Work Rolls	I-28813	SKF	1933
Strip	3-High	2	16½"	10¼"	16½"		Work Rolls	I-28818 I-112518	SKF	1933
Strip	Double 2-High	1	11"				Work Rolls	I-28804 I-112504	SKF	1933
Strip	2-High	1½	21"				Work Rolls	I-28824 I-112424	SKF	1933
Strip	3-High	5	12¾"	6¾"	12¾"		Work Rolls	I-28804 I-112504	SKF	1933
	3-High	1	10¼"				Pinion Stand	I-112407	SKF	1934
Edging	2-High	1	16½"				Work Rolls	22330 22320	SKF	1934
Strip	3-High	1	11"			Hungary	Work Rolls	I-26304	SKF	1924
Strip	2-High	1	18"			Japan	Work Rolls	I-28818	SKF	1932
Strip	2-High	3	18"				Work Rolls	I-28818	SKF	1932

Hot Sheet, Strip, and Plate Mills continued

Mill	Type	No. of Stands	Roll Data: Work Roll	Roll Data: Backig Roll	Roll Data: Body Ligth	Where Built or in Operation	Position of Bearing	Bearing No.	Make of Bearing	Year Instl'd
Continuous Strip	2-High	3	11"			Japan	Work Rolls	I-28806	SKF	1933
Skelp	2-High	2	15 3/4"				Work Rolls	I-28814	SKF	1933
Continuous Strip	3-High	4	17 3/4" 10 3/4" 17 3/4"				Work Rolls	I-28818 I-37603	SKF	1933
Strip	3-High	1	17 1/2"				Work Rolls	I-112617 22630 WUM-110 31330	SKF	1933
Strip	3-High	4	13 1/2"				Work Rolls	I-28810 I-37600	SKF	1934
Continuous Strip	3-High	2	9 3/4" 22"			Jugoslavia	Work Rolls	22252	SKF	1931
Strip	3-High	1	5 7/8" 12 3/8"			Luxemburg	Work Rolls	I-28809	SKF	1931
Strip	2-High	2	19 5/8"				Work Rolls	I-37611	SKF	1931
Strip	2-High	8				Russia	Work Rolls		SKF	1933
Strip	Double 2-High	4	13 3/4"			Sweden	Work Rolls	I-28812 I-34111	SKF	1930
Strip	2-High	1	13 3/4"				Work Rolls	I-28812 I-34111	SKF	1930
Strip	3-High	1 1/2	8 3/8" 14 3/8"				Work Rolls	I-28813 I-26300	SKF	1930
Strip	3-High	4	8 5/8" 15 3/4"				Work Rolls	I-28815 I-26300	SKF	1930
Strip	Alternating 2-High	10	9" 11 3/4"				Work Rolls	I-28804 I-34103	SKF	1930
Strip	3-High	2	8 7/8"				Pinion Stand	I-37602	SKF	1931
Strip	2-High 4-High	2	10"				Work Rolls	I-28805 I-112505	SKF	1933
Strip	3-High	1	9 3/4"				Work Rolls	I-37602	SKF	1933
Strip	3-High	1	10 1/4"				Pinion Stand	I-112407	SKF	1933
Continuous Strip	4-High	6	11"	26"		U.S.A.	Back-up Rolls	I-26315	SKF	1929

Cold Sheet, Strip & Tinplate Mills

	2-High	2	14"		12"	Canada	Work Rolls	22240 (I-34110)	SKF	1930
	2-High	1	15"		12"		Work Rolls	I-26308	SKF	1930
	Cluster	1	3 1/2"	9 1/2"		Czechoslovakia	Back-up Rolls	I-37602	SKF	1931
	Cluster	1	5 1/4"	14 3/4"			Back-up Rolls	I-37609	SKF	1932
	4-High	1	4 1/2"	10"			Back-up Rolls	I-37602	SKF	1933
	4-High	1	5 1/4"	12 1/8"		England	Back-up Rolls	22326-K	SKF	1931
	2-High	4	8"				Work Rolls	I-37600	SKF	1932
	4-High	1	9"	27"			Back-up Rolls	I-37615	SKF	1932
	4-High	1	7"	15"			Back-up Rolls	I-112415	SKF	1933

Cold Sheet, Strip and Tinplate Mills, continued

Mill	Type	No of Stands	Roll Data: Work Roll	Roll Data: Backing Roll	Roll Data: Body L'gth	Where Built or in Operation	Position of Bearing	Bearing No.	Make of Bearing	Year Inst'l'd
	4-High	1	9"	24"		England	Back-up Rolls	I-37615	SKF	1933
	4-High	1	7"	17"			Back-up Rolls	I-112416	SKF	1933
	4-High	2	5"	12"			Back-up Rolls	22328-K	SKF	1933
	4-High	1	15 3/4"	39 3/8"			Back-up Rolls	I-112640	SKF	1933
	4-High	1	6"	14"			Back-up Rolls	I-28813	SKF	1933
	4-High	1	7"	15"	20"		Back-up Rolls	I-112415	SKF	1934
	Cluster	6	5"	9 1/2"		France	Back-up Rolls	22320-K	SKF	1929
	Special 4-High	6	5 1/4"	13 3/4"			Back-up Rolls	I-37606 22310	SKF	1930
	Ring	1	3 1/8"	6 5/16"			Back-up Rolls	Supporting Rings	SKF	1933
	4-High	1	11"	23 1/2"		Germany	Back-up Rolls	I-37615	SKF	1929
	4-High	1	6 1/2"	19 3/4"			Back-up Rolls	I-37612	SKF	1930
	4-High	4	11"	23 1/2"			Back-up Rolls	I-37615	SKF	1930
	4-High	1	12 3/4"	31 1/2"			Back-up Rolls	I-37620	SKF	1930
	4-High	3	11"	23 1/2"			Back-up Rolls	I-66115	SKF	1930
	Cluster	1		5"			Back-up Rolls	22310	SKF	1930
	Cluster	1	7"	14 1/4"			Back-up Rolls	22238	SKF	1930
	Cluster	1	3"	6 1/4"			Back-up Rolls	22313	SKF	1930
	Cluster	1	6"	11 3/4"			Back-up Rolls	22232	SKF	1930
	4-High	15					Back-up Rolls	Cylindrical Roller Bearings	SKF	1930
	4-High	33					Back-up Rolls	Cylindrical Roller Bearings	SKF	1930 1931
	4-High	1	11"	29"	31 1/2"		Back-up Rolls	I-37832	SKF	1931
	4-High	1	10"	21 1/2"			Back-up Rolls	I-37613	SKF	1931
	4-High	1	4"	9 1/2"			Back-up Rolls	I-37602	SKF	1931
	4-High	1	11"	23 1/2"			Back-up Rolls	I-37615	SKF	1931
	4-High	3	11"	23 1/2"			Back-up Rolls	I-66115	SKF	1931
	4-High	1	8"	18 3/4"	18 3/4"		Back-up Rolls	I-37612	SKF	1931
	Cluster	1	5 1/2"	11"			Back-up Rolls	22228	SKF	1931
	Cluster	1	4"	8"			Back-up Rolls	22220	SKF	1931
	4-High	1	14 1/4"	36 1/4"	39"		Back-up Rolls	I-37620	SKF	1931
	2-High	2						Supporting Rollers	SKF	1931

Cold Sheet, Strip and Tinplate Mills, continued

Mill	Type	No of Stands	Roll Data: Work Roll	Roll Data: Backg Roll	Roll Data: Body L'gth	Where Built or in Operation	Position of Bearing	Bearing No	Make of Bearing	Year Instl'd
	4-High	2	13"	32"			Back-up Rolls	I-37620	SKF	1932
	4-High	3	14"	36 1/4"			Back-up Rolls	I-37620	SKF	1932
	Cluster	1	3 3/4"	7 1/2"			Back-up Rolls	22219	SKF	1932
	Cluster	1	4 1/2"	9 3/4"			Back-up Rolls	22226	SKF	1932
	4-High	1	15"	36"	32 1/4"		Back-up Rolls	I-112636	SKF	1932
	4-High	3	8"	19"			Back-up Rolls	I-112620	SKF	1932
	4-High	1	9"	21"			Back-up Rolls	I-112622	SKF	1932
	4-High	1	11"	23 1/2"			Back-up Rolls	I-37615	SKF	1932
	4-High	1	16"	37 1/2"	47 1/4"		Back-up Rolls	I-37621	SKF	1932
	4-High	1	7"	20"			Back-up Rolls	I-37612	SKF	1932
	Cluster	2	13"	27"			Back-up Rolls	I-26317	SKF	1932
	Cluster	1	5"	9 1/2"			Back-up Rolls	I-26320	SKF	1932
	3-High	1					Work Rolls		SKF	1932
	4-High	10	4"	10"			Back-up Rolls	22226-K	SKF	1932
	4-High		4"	9"			Back-up Rolls	22222	SKF	
	4-High		4"	9 1/2"		Germany	Back-up Rolls	22224	SKF	
	Cluster		8 1/4"	16 1/2"	21 1/2"		Back-up Rolls	22244	SKF	
	4-High		11"	23 1/2"			Back-up Rolls	22260	SKF	
	Cluster		5"	10"			Back-up Rolls	22322	SKF	
	4-High		5 1/2"	13"			Back-up Rolls	22328	SKF	1928
	Cluster	215	6 1/4"	14"	19 3/4"		Back-up Rolls	22332	SKF	To
	Cluster		9"	18"			Back-up Rolls	22340	SKF	1932
	Cluster		3"	6 1/2"			Back-up Rolls	I-26314	SKF	
	4-High		12"	29 1/2"			Back-up Rolls	I-26318	SKF	
	Cluster		15"	30"			Back-up Rolls	I-26319	SKF	
	Cluster		13 1/2"	27"			Back-up Rolls	I-26317	SKF	
	4-High		14"	34"			Back-up Rolls	I-26320	SKF	
	4-High	2	12"	29 1/2"			Back-up Rolls	I-37618	SKF	1933
	4-High	1	13 3/4"	37 1/2"	75"		Back-up Rolls	I-37620	SKF	1933

Cold Sheet, Strip, and Tinplate Mills, continued

Mill	Type	No. of Stand	Roll Data: Work Roll	Roll Data: Backg Roll	Roll Data: Body Lgth	Where Built or in Operation	Position of Bearing	Bearing No.	Make of Bearing	Year Instl'd
	Cluster	1	4 3/4"	9 7/8"			Back-up Rolls	I-37603	SKF	1933
	4-High	1	8"	19"			Back-up Rolls	I-112620	SKF	1933
	Cluster	1					Back-up Rolls	I-116858	SKF	1933
	3-High	30	8"	3 9/16"	8"		Work Rolls	22226-K	SKF	1933
	4-High	1	7"	19"			Back-up Rolls	I-37612	SKF	1933
	3-High	2	8"	3 9/16"	8"		Work Rolls	I-37602	SKF	1933
	2-High	1	4"				Work Rolls	I-115414	SKF	1933
	4-High	1					Back-up Rolls	I-112432	SKF	1933
	Ring	1	6 5/16"	3 1/8"	6 5/16"	8"		Supporting Rings	SKF	1933
	4-High	1					Back-up Rolls	I-112426	SKF	1933
	2-High	1	9 1/16"				Work Rolls	I-28804 I-112404	SKF	1933
	4-High	1	11"	28"			Back-up Rolls	I-112432	SKF	1933
	4-High	3	9"	21"			Back-up Rolls	I-112622	SKF	1933
	4-High	4	5"	13"			Back-up Rolls	I-112610	SKF	1933
	4-High	1	11"	23 1/2"		Germany	Back-up Rolls	I-37615	SKF	1933
	Special 2 High	2	3 1/8"	6 5/16"	8"			Supporting Rollers	SKF	1933
	4-High	1	7 7/8"	18 1/8"			Back-up Rolls	I-112420	SKF	1933
	2-High	6	6" & 8"				Work Rolls	Various Cylindrical Roller Bearings	SKF	1933
	4-High	2	9 7/8"	23 5/8"			Back-up Rolls	I-112626	SKF	1933
	4-High	3	5 7/8"	18 1/2"			Back-up Rolls	I-37612	SKF	1933
	3-High	10					Work Rolls	Various Roller Bearings	SKF	1933
	4-High	1	5 1/4"	13"			Back-up Rolls	22328-K	SKF	1934
	3-High	2	15 3/4"	24 3/8"			Work Rolls	I-112436	SKF	1934
	2-High	2	15 3/4"				Work Rolls	I-28814	SKF	1934
	2-High	8					Work Rolls	Various Roller Bearings	SKF	1934
	4-High	1	11"	27"			Back-up Rolls	I-112430	SKF	1934
	4-High	3					Back-up Rolls	RUWL-160e	SKF	1934
	4-High	3					Back-up Rolls	RUWL-110e	SKF	1934
	3-High	1	4 1/2"	10"			Work Rolls	22330-K	SKF	1934

Cold Sheet, Strip and Tinplate Mills, continued

Mill	Type	No. of Stands	Roll Data: Work Roll	Roll Data: Backg Roll	Roll Data: Body Lgth	Where Built or in Operation	Position of Bearing	Bearing No.	Make of Bearing	Year Instl'd
	4-High	1	5"	13"		Italy	Back-up Rolls	22232-K	SKF	1933
	4-High	1	4 1/2"	11 1/2"			Back-up Rolls	22328-K	SKF	1931
	4-High	2	5"	12"			Back-up Rolls	22326-K	SKF	1931
	4-High	1	5 7/8"	13"			Back-up Rolls	I-37605	SKF	1932
	4-High	2	3 3/4"	11 3/8"			Back-up Rolls	I-37906	SKF	1932
	4-High	1	7"	16"			Back-up Rolls	I-37610	SKF	1932
	2-High	1	13 1/2"				Work Rolls	I-37606	SKF	1932
	4-High	1	5"	12 1/2"			Back-up Rolls	I-37605	SKF	1932
	4-High	1	5 7/8"	13"			Back-up Rolls	I-37613	SKF	1932
	4-High	2	4 9/16"	13"		Japan	Back-up Rolls	22328-K	SKF	1932
	4-High	1	3 7/8"	10 13/16"			Back-up Rolls	22322-K	SKF	1932
	4-High	3	8 11/16"	21 5/8"			Back-up Rolls	I-112622	SKF	1933
	4-High	1	5 7/8"	13"			Back-up Rolls	I-37605	SKF	1933
	Ring	1	3 1/4"	6 1/4"				Supporting Rings	SKF	1933
	4-High	1	10 13/16"	23 5/8"			Back-up Rolls	I-32074	SKF	1933
	4-High	1	5 7/8"	13"			Back-up Rolls	I-37605	SKF	1933
	4-High	1	3 7/8"	11 13/16"			Back-up Rolls	I-112408	SKF	1933
	4-High	4	4 9/16"	11 13/16"			Back-up Rolls	I-112408	SKF	1933
	4-High	2	4 9/16"	11 13/16"			Back-up Rolls	I-112408	SKF	1933
	Ring	1	6 3/8" 3 3/16" 6 3/8"			Poland		Supporting Rings	SKF	1933
	Ring	1	8" 4" 8"		8"			Supporting Rings	SKF	1927
	Ring	1	6 1/4" 3 1/4" 6 1/4"		7"			Supporting Rings	SKF	1930
	Ring	8	5 1/8" 2 1/2" 5 1/8"		7"			Supporting Rings	SKF	1930
	Ring	1	5 1/8" 2 1/2" 5 1/8"		7"			Supporting Rings	SKF	1930
	Ring	8	5 1/8" 2 1/2" 5 1/8"		7"	Sweden		Supporting Rings	SKF	1931
	Cluster	9	6 1/4"	14 1/4"			Back-up Rolls	22332	SKF	1931
	Ring	2	6 1/4" 3 1/4" 6 1/4"		8"			Supporting Rings	SKF	1932
	2-High	1	4"				Work Rolls		SKF	1933
	2-High	1	4"				Work Rolls	I-116041	SKF	1933

Cold Sheet, Strip, and Tinplate Mills, continued

Mill	Type	No. of Stands	Roll Data: Work Roll	Roll Data: Backup Roll	Roll Data: Body Length	Where Built or in Operation	Position of Bearing	Bearing No.	Make of Bearing	Year Inst'l'd
	Cluster	1	6 1/4"	14 1/4"		Sweden	Backup Rolls	22332-K	SKF	1933
	4-High	4	5"	12"			Backup Rolls	22230-K	SKF	1933
	4-High	1	9"	24"			Backup Rolls	I-112428	SKF	1933
	2-High	2	10 5/8"			U.S.A.	Work Rolls	7813 6228X376	SKF	1927
	2-High	1	12 1/2"				Work Rolls	I-26306	SKF	1928
	4-High	8	2 3/4"	6 3/4"			Backup Rolls	22315	SKF	1928
	4-High	1	3 3/4"	14 1/2"			Backup Rolls	22332	SKF	1929
	2-High	20	8 3/8"				Work Rolls	I-70176 6221	SKF	1930
	2-High	20	10 5/8"				Work Rolls	I-70177 6228X	SKF	1930
	2-High	2	13"				Work Rolls	I-70192 6234X	SKF	1930
	2-High	3	16 1/2"				Work Rolls	I-70191 I-70193	SKF	1930
	4-High	1	12"	29 1/2"			Back-up Rolls	I-26318	SKF	1929

Rod, Rail, Structural & Merchant Mills

Continuous Rod	2-High	14	9 3/4"			Canada	Work Rolls	I-37603 I-34105	SKF	1930
Rod	3-High	7	11"			Czecho-slovakia	Work Rolls	I-26304 I-26305	SKF	1926
	3-High	1	12"				Pinion Stand	I-37605	SKF	1933
Continuous Rod	2-High	7	12"			England	Work Rolls	22222	SKF	1925
Rod	2-High	1	9 7/8"				Work Rolls	I-37602 I-34108	SKF	1927
Continuous Rod	2-High	6	10"				Work Rolls	22320	SKF	1929
Rod	Alternating 2-High	2	10 3/4"				Work Rolls	I-37604 I-110504	SKF	1931
Bar	2-High	1	12 5/8"				Work Rolls	I-28809 I-34108	SKF	1931
Rod	2-High	1	12 3/4"				Pinion Stand	I-37606	SKF	1931
Rod	Alternating 2-High	1	10 7/8"				Work Rolls	I-37604 I-110504	SKF	1933
Rod	2-High	4	9 7/8"				Work Rolls	I-26302 NM-80	SKF	1933
Rod	2-High	12	11"				Work Rolls	I-26303	SKF	1933
Continuous Rod	2-High	12	11"			France	Work Rolls	I-37604 I-33502	SKF	1931
Rod	3-High	2	9 1/2"				Pinion Stand	I-37603	SKF	1932
Merchant	3-High	1	13 3/4"			Germany	Work Rolls	I-37607	SKF	1924
Rod	Double 2-High	3	9"				Work Rolls	I-28803 I-34103	SKF	1928

Rod, Rails, Structural, and Merchant Mills, continued

Mill	Type	No. of Stands	Roll Data: Work Roll	Roll Data: Back'g Roll	Roll Data: Body Length	Where Built or in Operation	Position of Bearing	Bearing No.	Make of Bearing	Year Inst'l'd
Merchant	Double 2-High	7	12"				Work Rolls	I-28809 I-34108	SKF	1929
Rod	2-High	1	9 7/8"				Work Rolls	I-28805 I-34104	SKF	1929
Rod	Double 2-High	1	9 7/8"				Work Rolls	I-28804 I-34103	SKF	1930
Continuous Rod	2-High	8	11"				Work Rolls	I-37604 I-33502	SKF	1931
Rod	Double 2-High	1	9"				Work Rolls	I-28803 I-34102	SKF	1931
Rod	Alternating 2-High	1	11 7/8"				Work Rolls	I-28806 I-33503	SKF	1931
Rod	Alternating 2-High	4	9 1/2"				Work Rolls	I-28804 I-112504	SKF	1933
Rod	Alternating 2-High	1	11 1/2"			Germany	Work Rolls	I-28806 I-33503	SKF	1933
Rod	Alternating 2-High	1	11 5/8"				Work Rolls	I-28805 I-34104	SKF	1933
Bar	2-High	1	11 1/2"				Work Rolls	I-37604 I-33502	SKF	1933
Rod	2-High	2	11 3/4"				Work Rolls	I-28808 I-112508	SKF	1933
Rod	2-High	1	9 3/4"				Work Rolls	I-28805 I-112505	SKF	1934
Rod	2-High	7	9 3/4"				Work Rolls	I-28805 I-112505	SKF	1934
Rod	2-High	6	9 3/4"				Work Rolls	I-28806 I-112506	SKF	1934
Rod	3-High	1	9 3/4"				Pinion Stand	I-112606	SKF	1934
Rod	Alternating 2-High	1	9 3/4"			Hungary	Work Rolls	I-28806 I-34105	SKF	1932
Rod	3-High	1	9 3/4"			Italy	Pinion Stand	I-37603	SKF	1930
Rod	Alternating 2-High	6	9 3/4"				Work Rolls	I-28805 I-34104 I-28806 I-33503	SKF	1932
Rod	Double 2-High	1	12 1/4"			Japan	Pinion Stand	I-37606	SKF	1931
Rod	Alternating 2-High	8	9 3/4"				Work Rolls	I-28805 I-33503 I-28806 I-34104	SKF	1932
Merchant	3-High	1	14"				Work Rolls	I-37606	SKF	1933
Structural	2-High	1				Luxemburg	Vertical Stand	22340	SKF	1932
Merchant	3-High	2	17 3/4"			Roumania	Work Rolls	I-26311	SKF	1926
Rod	3-High	5	11"				Work Rolls	I-33022	SKF	1926
Rod	Alternating 2-High	3	11"			Saar	Work Rolls	I-28805 I-34104	SKF	1931
Rod	3-High	1	10 1/2"				Pinion Stand	I-37603	SKF	1931
Rod	Alternating 2-High	1	11"				Work Rolls	I-28805 I-34104	SKF	1931
Rod	2-High	5	11"			South Africa	Work Rolls	I-37604 I-33502	SKF	1932
Merchant	3-High 2-High	3	12 3/4"			Spain	Work Rolls	I-28808 I-34107	SKF	1929

Rod, Rail, Structural, and Merchant Mills, continued

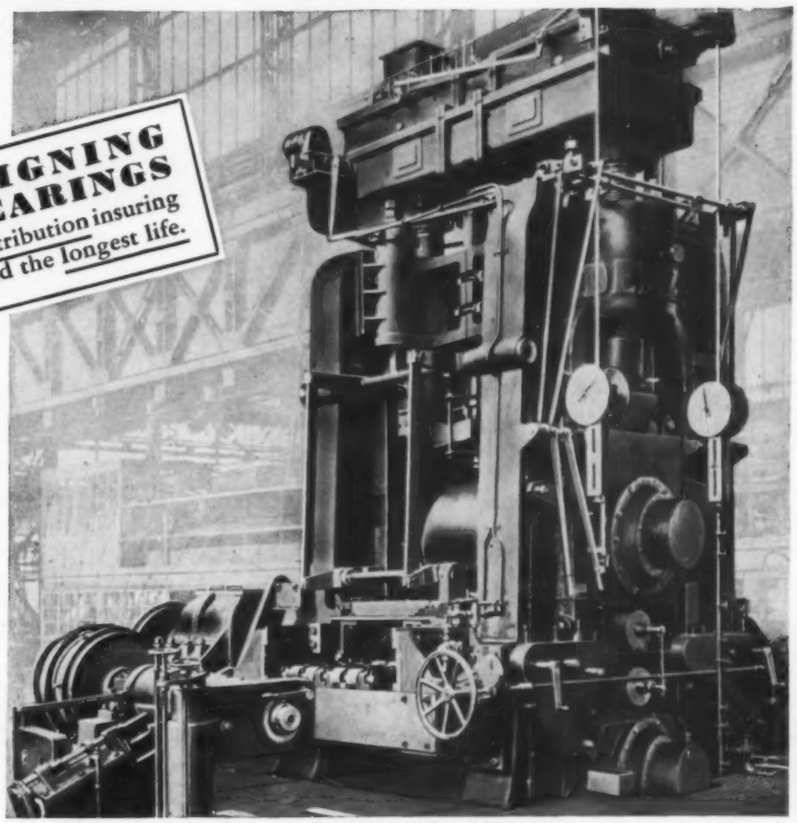
Mill	Type	No of Stands	Roll Data: Work Roll	Roll Data: Backg Roll	Roll Data: Body L'gth	Where Built or in Operation	Position of Bearing	Bearing No.	Make of Bearing	Year Inst'l'd
Rod	Alternating 2-High	9	9" 11¾"			Spain	Work Rolls	I-28804 I-34103	SKF	1930
Rod	3-High	4	13⅜"				Work Rolls	I-28809 I-34109	SKF	1930
Structural	2-High	2	16⅛"				Work Rolls	I-28812 I-112512	SKF	1933
Rod	3-High	2	8⅞"				Work Rolls	I-28802 I-34106	SKF	1925
Rod	Alternating 2-High	11	9½"			Sweden	Work Rolls	I-37601 I-34107	SKF	1925
Rod	3-High	8	8⅞"				Pinion Stands	I-37601 I-34107	SKF	1925
Merchant	3-High	2	16¾"				Work Rolls	I-26310	SKF	1925
Merchant	3-High	1	16¾"				Pinion Stand	I-26310	SKF	1925
Rod	2-High	1	21⅝"				Work Rolls	I-37612 I-33511	SKF	1926
Rod	3-High	5	13¾"				Work Rolls	I-28810 I-34110	SKF	1926
Rod	2-High	2	9¾"				Work Rolls	I-28804 I-34108	SKF	1927
Rod	2-High	2	8¾"				Work Rolls	I-28804 I-34103	SKF	1927
Rod	3-High Alternating 2-High	7	9¾" 12¼"				Work Rolls	I-28804 I-34104	SKF	1928
Rod	3-High Alternating 2-High	1	9¾" 12¼"				Pinion Stand	I-37602	SKF	1928
Merchant	3-High Alternating 2-High	3	17¾"				Work Rolls	I-28814 I-34114	SKF	1928
Merchant	3-High	1	17¾"				Pinion Stand	I-37610	SKF	1928
Merchant	2-High	1	15¾"				Work Rolls	I-28814 I-34114	SKF	1929
Rod	2-High	2	11"				Work Rolls	I-28802 I-34102	SKF	1930
Rod	Alternating 2-High	5	7⅞" 10¼"				Work Rolls	I-28802 I-34102	SKF	1931
Merchant	3-High	1	9⅞"				Work Rolls	I-28803 I-112503	SKF	1931
Rod	Alternating 2-High	6	10"				Work Rolls	I-28805 I-112505	SKF	1932
Merchant	3-High	2	9½"				Work Rolls	I-28803 I-112503	SKF	1932
Merchant	3-High	2	16¾"				Work Rolls	I-28814 I-112514	SKF	1933
Rod	Alternating 2-High	6	9¼" 10⅞"				Work Rolls	I-28803 I-112503	SKF	1933

Tube Piercing, Reeling & Electrical Welding Mills

Tube Reducing	2-High	3	14"			England	Work Rolls	22318 I-39516	SKF	1929
Tube Reducing	3-High	2	15¾"			Sweden	Work Rolls	22232-K I-34110	SKF	1928
Bar Reeling	2-High	1	8"				Work Roll	22320-K	SKF	1933
Bar Reeling	2-High	1	8"				Work Roll	22311-K	SKF	1933

Tube Piercing, Reeling, & Electrical Welding Mills, continued										
Mill	Type	No. of Stands	Roll Data: Work Roll	Roll Data: Back'g Roll	Roll Data: Body L'gth	Where Built or in Operation	Position of Bearing	Bearing No.	Make of Bearing	Year Inst'ld
Bar Reeling		3	16"			Sweden		I-37607	SKF	1926
Tube Reeling		1	16"					22328	SKF	1924
Tube Reeling		1	24"					22340	SKF	1931
Tube Reeling		1	16"					22328	SKF	1931
Reeling		2	28"			U.S.A.		22338	SKF	1928
Reeling		2	24"					22336	SKF	1928
Gauging Mill	2-High	21						I-26303	SKF	1929
Reeling		1	27 1/4"					22344	SKF	1929
Piercing		1	27 1/4"					22344	SKF	1931
Reeling		2	40" Disc					I-70302	SKF	1932
Gauging Mill	2-High	21						I-26303	SKF	1934
Tube Mill	2-High	1						I-26304	SKF	1934
Cold Wire-flattening Mills										
	2-High	55	8" 10"			England			SKF	1930 to 1933

SKF SELF-ALIGNING ROLL NECK BEARINGS provide an equalized load distribution insuring the full bearing capacity and the longest life.



SKF-equipped 37½" x 47¼"—4-High Cold Mill Built by Demag, Germany

1037 STANDS

***THE WORLD OVER* ARE RUNNING ON SKF SELF-ALIGNING ROLL NECK BEARINGS!** This is more than twice as many as any other roller bearing . . . another SKF record of exceptional performance!

When there are two *self-aligning* roller bearings on a neck, mounted in a *pivoting* chock, the assembly has these exclusive features:

1. EQUALIZED LOAD DISTRIBUTION . . . because the neck load is divided equally on four rows of rollers, even under severe neck deflection.

2. FULL BEARING CAPACITY . . . because the self-alignment of the bearings prevents excessive stress concentration due to binding or pinching . . . reserves the entire bearing capacity for useful load.

3. LONGEST LIFE . . . because the equalized and controlled load distribution on the rollers results in low bearing stresses.

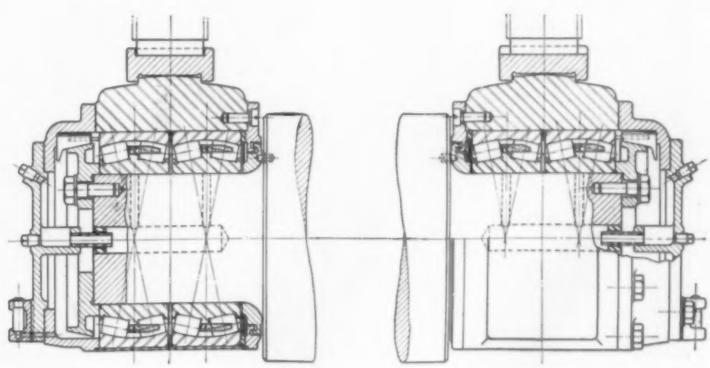
CHARACTERISTICS OF SKF SPHERICAL ROLL NECK BEARINGS

1. Completely self-aligning.
2. High radial and thrust capacity.
3. Full surface contact between rollers and guide flange insuring unexcelled roller guidance.
4. Low friction and absence of wear.

SKF INDUSTRIES, INC.,
FRONT ST. and ERIE AVE.,
PHILADELPHIA, PA.

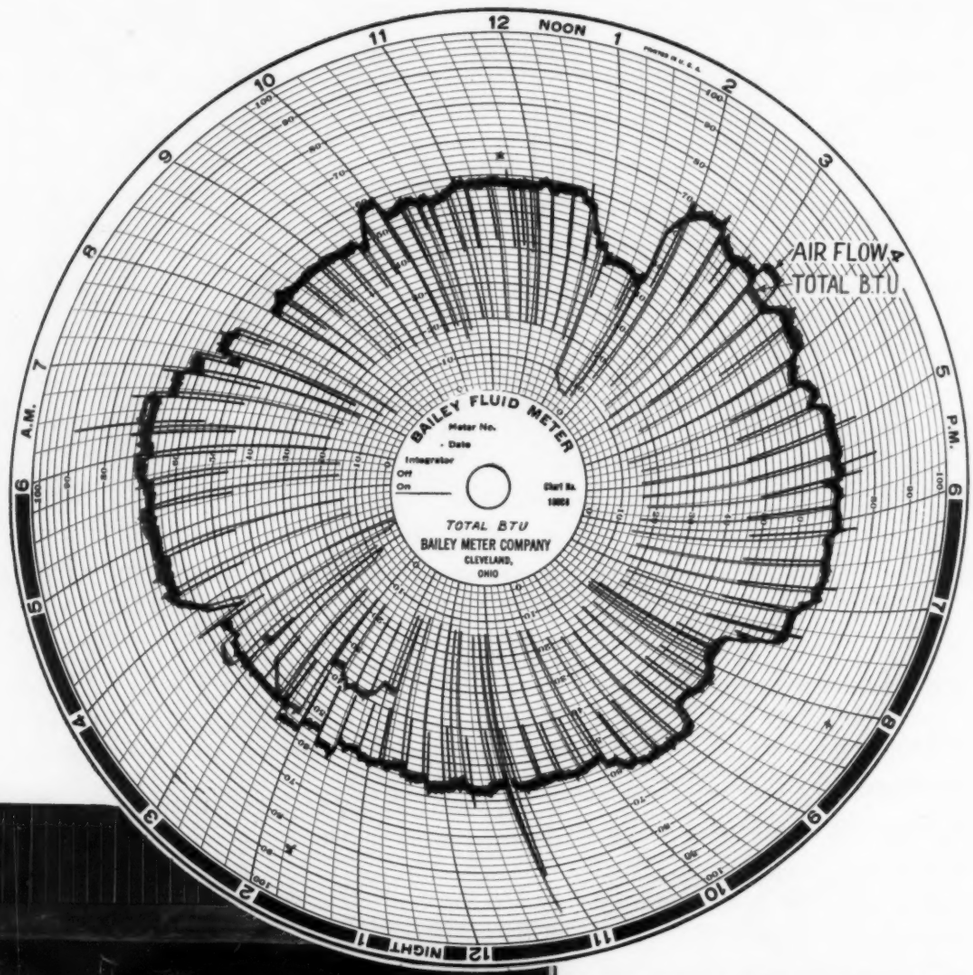
3290

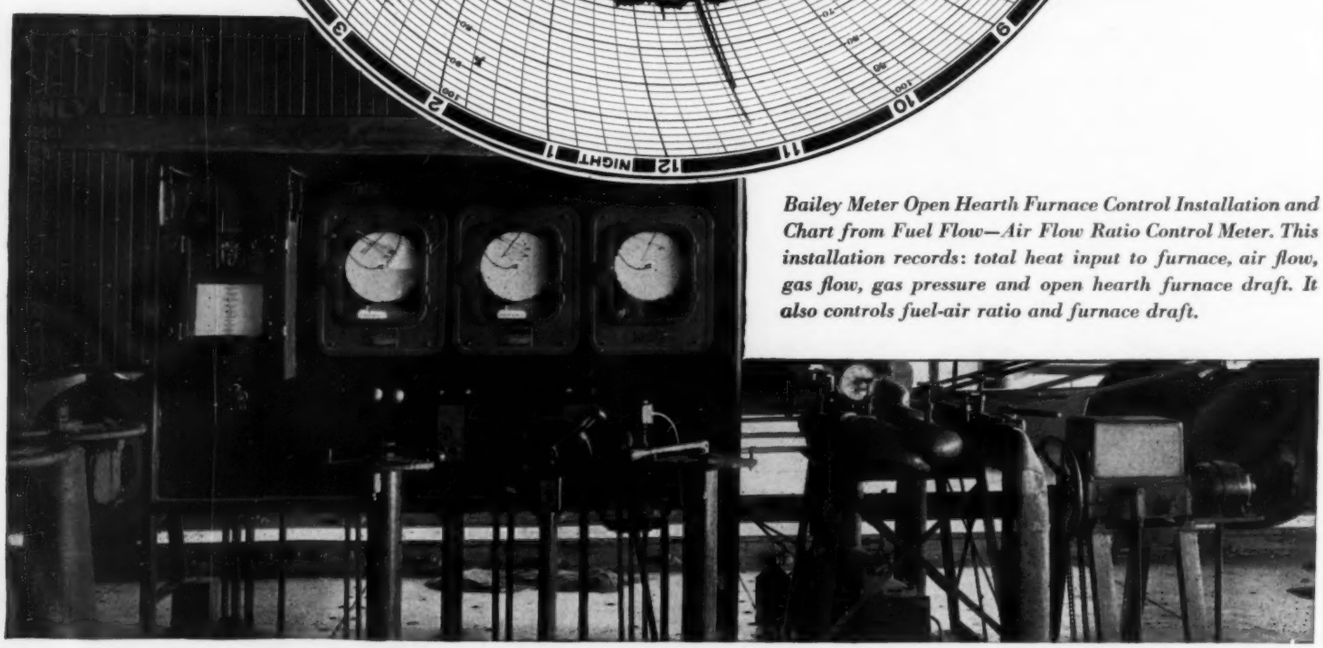
SKF
Roller Bearings



Meters

Remove the Guesswork from





Bailey Meter Open Hearth Furnace Control Installation and Chart from Fuel Flow—Air Flow Ratio Control Meter. This installation records: total heat input to furnace, air flow, gas flow, gas pressure and open hearth furnace draft. It also controls fuel-air ratio and furnace draft.

and Control

Steel Making Operations . . .

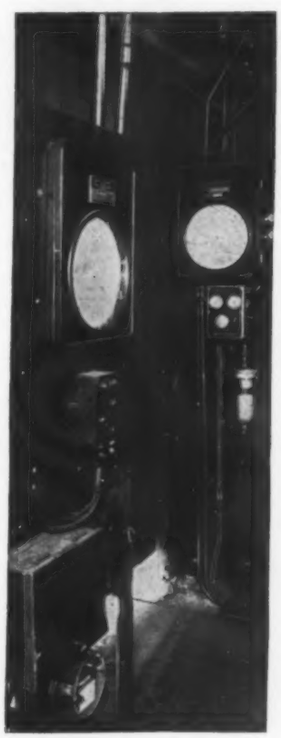
Why guess at temperatures, combustion conditions, drafts, B. t. u. inputs, and other important factors? Bailey Pyrometers, Ratio Meters, Draft Gages, Oil, Tar and Gas Meters give you the true picture and Bailey Control Systems increase capacity and efficiency.

STEEL OPERATORS are rapidly coming to recognize the benefits which are realized from the proper use of metering and controlling equipment. Experience of companies operating furnaces both with and without Bailey Meters and control conclusively indicates that this equipment is of the utmost value in saving fuel, reducing maintenance and increasing furnace capacity.

The metering equipment furnishes accurate information on quantities of air supplied for combustion at all phases of the heat and makes it possible to compare various methods of operation with results obtained.

Once the best operating procedure is determined by these comparisons it can be rigidly adhered to by the Bailey Control System which automatically maintains fuel-air ratio and furnace draft. By this procedure the maximum capacity and efficiency is realized on a furnace equipped with Bailey Meters and Control.

It will be decidedly worth your while to investigate the benefits which may be derived from installing Bailey Meters and Control on your furnaces. Write for complete information or call the nearest Bailey office.



Bailey Galvatron Potentiometer Pyrometer Controller and Fuel Flow—Air Flow Ratio Controller installed in a Midwestern steel mill.

BAILEY METER COMPANY

1047 IVANHOE ROAD, CLEVELAND, OHIO

BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

DON'T OVERLOOK SMALLER

Reliance has pioneered in the development of direct drives for rollers as used for this hot-table and cooling bed.

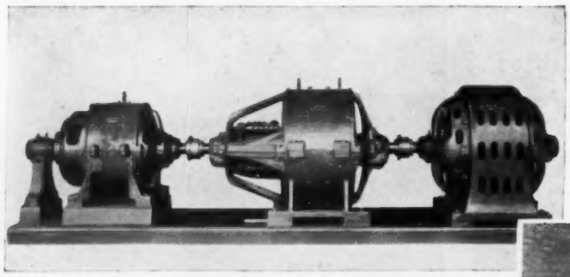
The 71 hot-table rollers are driven by Type AA Squirrel-Cage Motors directly connected by flexible couplings. These motors operate on an adjustable frequency and voltage to provide a table speed of 600/1200 f.p.m.

By means of direct-current braking, rollers are stopped within two seconds even from high speed. More than 120 stops an hour are made on the average.

WHEN you seek the cost-reducing features of modern continuous mills don't overlook the importance of the motor applications such as shown here. Though not impressive in h.p. rating, these motors in a 72″ continuous mill play a big part in gaining lower tonnage costs.

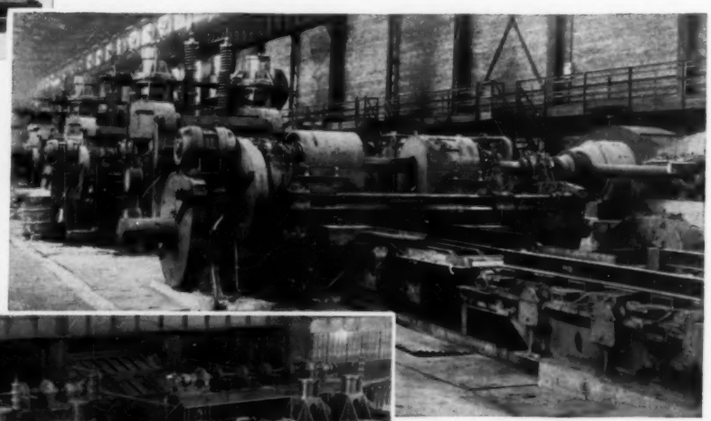
Call in a Reliance man. He represents experience which has come through a specialized study of applying general and special-purpose motors for this work.

• • •



Reliance Alternator Set which supplies current for operating runout-table motors on a variable frequency. Consists of d-c adjustable-speed, Type T driving motor, a 16-37 cycle alternator, and a low-voltage Type T d-c generator which supplies power for electrical braking.

The direct-current braking is a patented Reliance feature. Less heat is developed and less power consumed by this method. Quicker and more accurate stopping is possible.

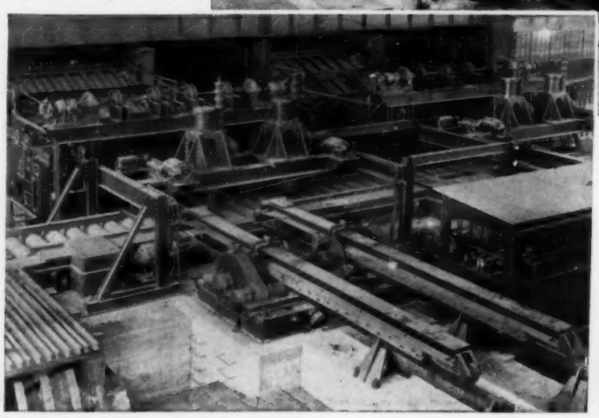


Here is a sample case where Reliance Engineers have saved money for steel mills by supplanting d-c mill motors with simpler, lower-cost squirrel-cage motors designed with the necessary torque and inertia characteristics. For the edger adjustments shown here a 15 h.p. special-torque squirrel-cage motor with control was supplied at one-third the cost of d-c equipment.

The four Vertical Edgers are each driven by 150 h.p., 600/900 r.p.m., Type T Reliance Heavy-duty D-C Motors. These motors are provided with a slightly drooping speed characteristic.

•

The Reliance Improved Motor-drive for Furnace Doors is used in this mill. This drive is simple in construction and easy to operate. Its first cost is low and upkeep expense is slight.



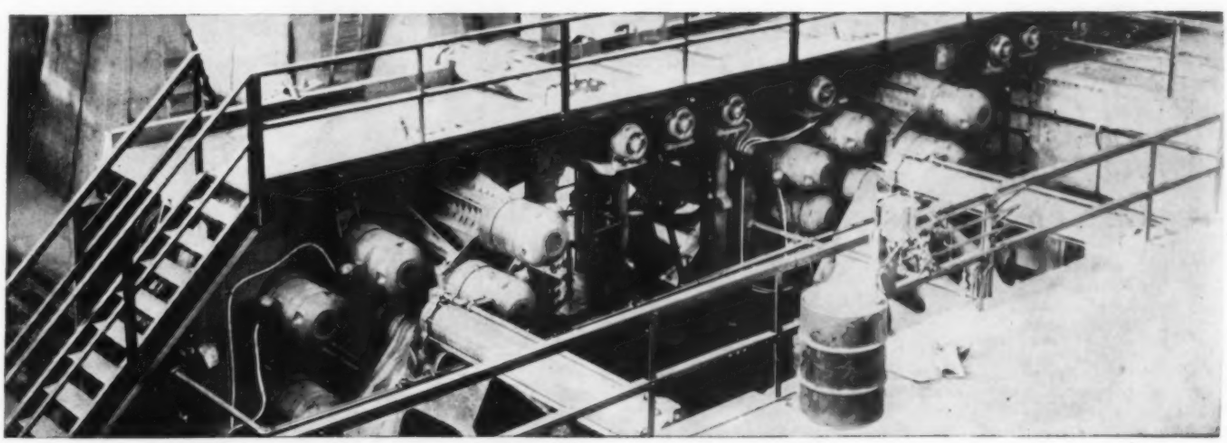
RELIANCE A-C D-C MOTORS

these . . UNITS !

This 15 h.p., 400/1600 r.p.m., Type T Heavy-duty Reliance D-C Motor is used for the pinch rolls at piler in connection with the flying shear.

•

Flying Shear driven by 150 h. p., 400/800 r.p.m., Type T Heavy-duty D-C Motor.



These two United 72″ Strip Mill Coilers are each equipped with eight Fully-enclosed Fan-cooled Reliance Squirrel-Cage Motors. The motors are supported by flange mountings and directly connected to the coiler rolls.

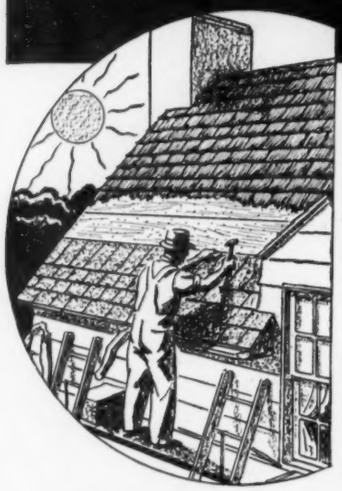
This is not an every-day job for motors. Dust and water must be excluded. Careful calculations must be made to determine the correct motor sizes and the necessary design characteristics. Experience counts and Reliance Engineers have had experience.

RELIANCE ELECTRIC & ENGINEERING CO.

IVANHOE ROAD - - - CLEVELAND, OHIO

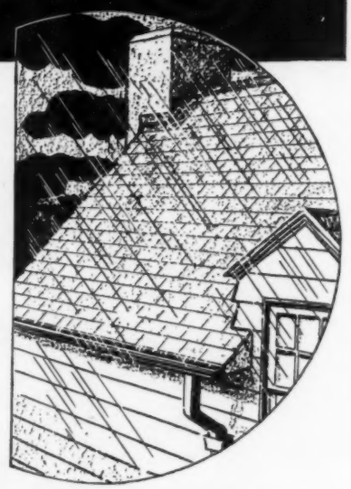
Branches: BIRMINGHAM - BOSTON - BUFFALO - CHICAGO - CINCINNATI
DETROIT - NEW YORK - PHILADELPHIA - PITTSBURGH - WASHINGTON
Representatives in other principal cities

When Preparation Provides Protection



SYSTEMATIC inspection and maintenance of brushes, brush holders, commutators and slip rings provide longer brush life, more satisfactory performance and freedom from expensive shut-downs.

Now is the time, with load and service conditions normal, to prepare for the sustained loads and heavy peaks of winter service.



INSTALL NATIONAL PYRAMID BRUSHES

A few specific recommendations

Grade 234	for Heavy Duty Generators and Rotary Converters.
Grade 255	for Industrial Motors.
Grade AX5	for High Speed, Mill Type Motors and Heavy Traction Motors.
Grade 401	for Normal Duty Table, Screw-Down, Crane and Hoist Motors.
Grade 850	for Heavy Duty Table, Screw-Down, Crane and Hoist Motors.
Grade 402	for Normal Duty Electric Traction Motors.
Grade ET10	for Rotary Converter Slip Rings.
Grade AYK	for Railway Rotary Converter Slip Rings.
Grade AY	for Induction Motor Slip Rings.
Grade 634	for Alternator and Synchronous Motor Field Rings.
Grade 441	for Dinkey Controller Contacts.
Grade 840	for Circuit Breaker Contacts.

N C C

NATIONAL PYRAMID BRUSHES

meet these exacting demands and keep the wheels of industry turning

NATIONAL CARBON COMPANY, INC.
Carbon Sales Division, Cleveland, Ohio
Unit of Union Carbide UCC and Carbon Corporation
Branch Sales Offices: New York • Pittsburgh • Chicago • San Francisco

These Fuses Protect both Your Motors and Payroll

Anybody knows that production interruptions are expensive. Machines and motors must have protection . . . fuses . . . but time-costs need protection, too. Fuses that blow on harmless overloads mean payroll losses.

Jefferson Super-Lag Renewable Fuses are the perfect answer. They provide reliable, ACCURATE protection—ride over all harmless surges, operate positively on dangerous overloads. There is no better protection for electrical equipment and property.

Jefferson Super-Lag Fuses are made in all capacities, both knife blade and ferrule types. Save your motors and payroll by specifying Jefferson Super-Lag Fuses.

JEFFERSON ELECTRIC COMPANY

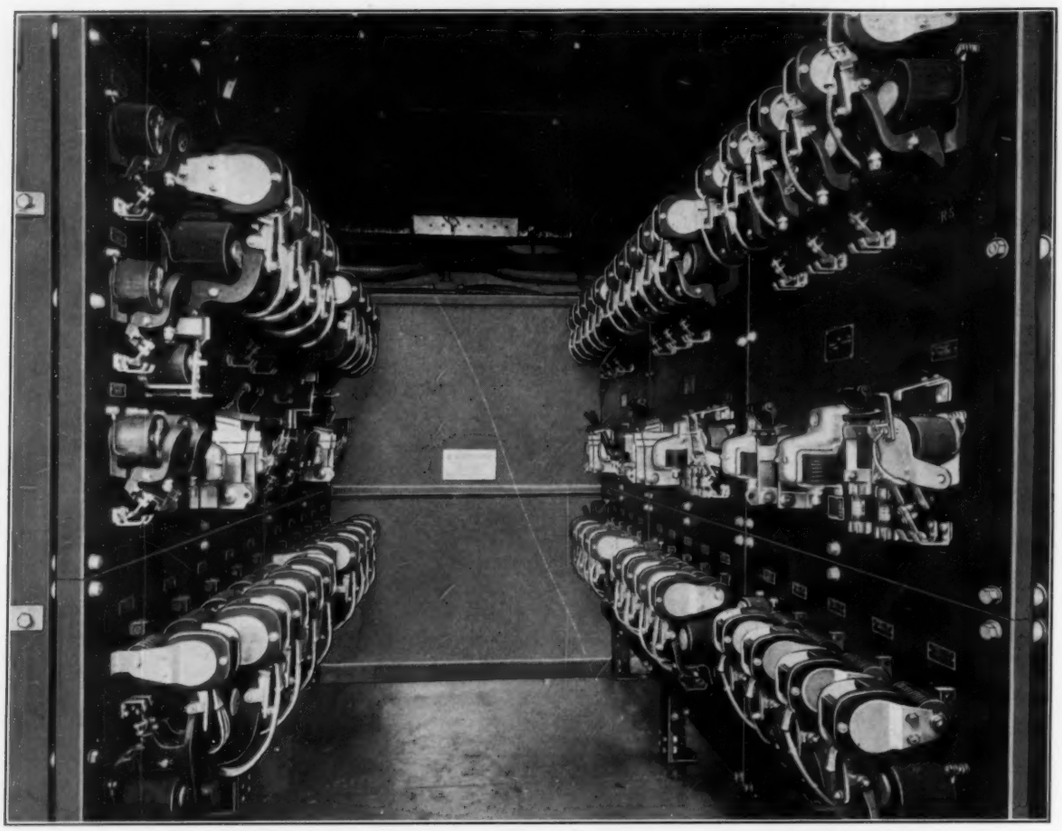
BELLWOOD (Suburb of Chicago) ILLINOIS

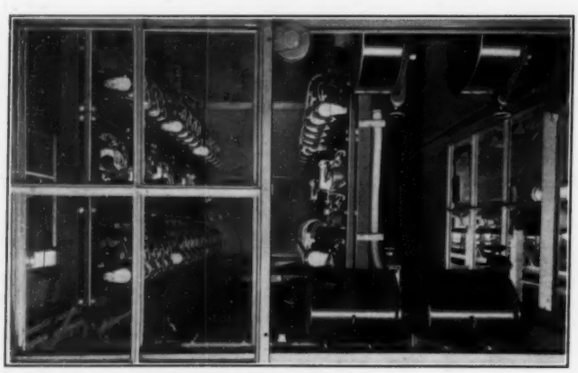
The secret of Jefferson Super-Lag performance lies in the lag plate which is a part of the Super-Lag link. This plate delays the normal fuse action to provide a time interval or LAG. This time-lag prevents the fuse from blowing on harmless temporary overloads—to save needless shutdowns and many link replacements.

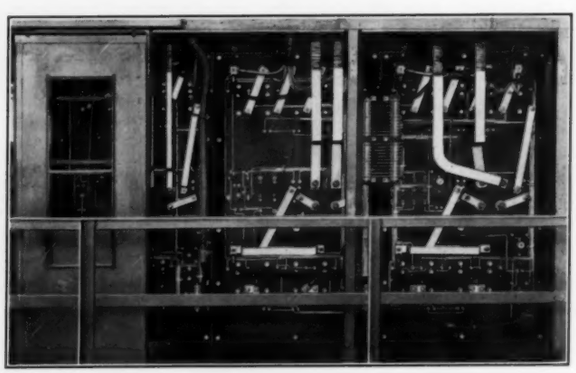
JEFFERSON Super-Lag RENEWABLE FUSES

B—136

CLARK CRANE CONTROL







Above photographs show an installation of Clark Control operating a 100 Ton 90 Ft. Span Crane with auxiliary hoist. Comprises two Clark Dynamic Braking High Speed Lowering Hoist Boards, one Duplex (2-motor) Bridge Control and one Reversing, Plugging, Trolley Control. Note the simplicity of the wiring as shown by the rear of board view of the Duplex Control. This is made possible by the "Vari-Time" feature which is exclusive with Clark. Write for Bulletin 9130.

This is a recent steel mill installation in Ohio.

Additional interesting details will be furnished on request.

THE CLARK CONTROLLER CO.

CLEVELAND, OHIO

A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

Alliance

"LARGEST BUILDERS OF THE WORLD'S LARGEST CRANES"

Present day demand for quality steel makes it necessary for you to be prepared to strip steel ingots with little end up or big end up, both with and without hot tops. Heretofore there has been no single machine capable of stripping all these different types of ingots.

ALLIANCE with its reputation of originating every known improvement in steel mill cranes during its thirty-two years of life, has designed, built, and placed in operation a

COMBINATION STRIPPER AND EXTRACTOR

that will perform all these operations. An electric working model of this machine is on exhibition in Booth No. 33.

✦ ✦

THE ALLIANCE MACHINE CO.

Designers and Builders - ALLIANCE, OHIO

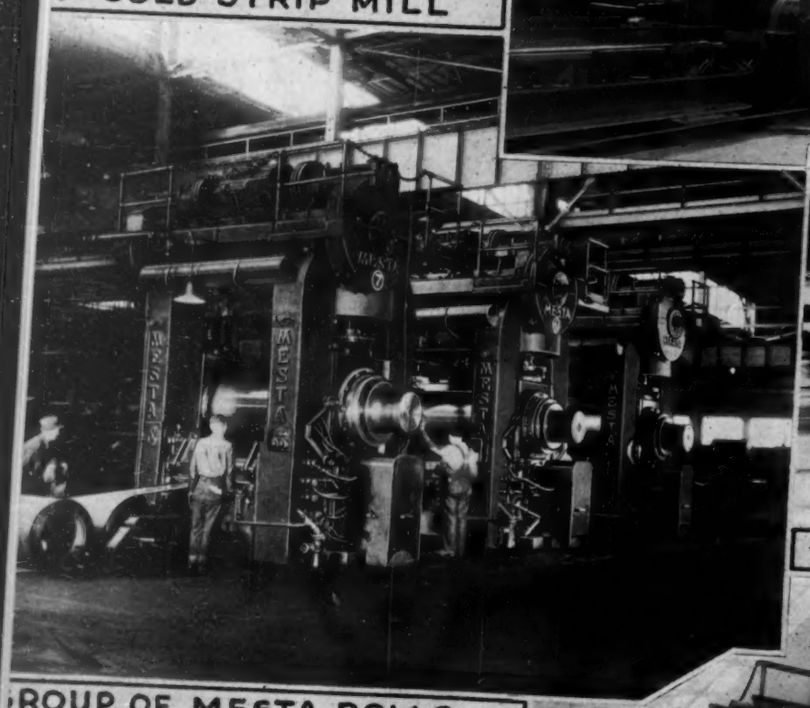
A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

BUILT

40" BLOOMING MILL

38" HOT STRIP MILL

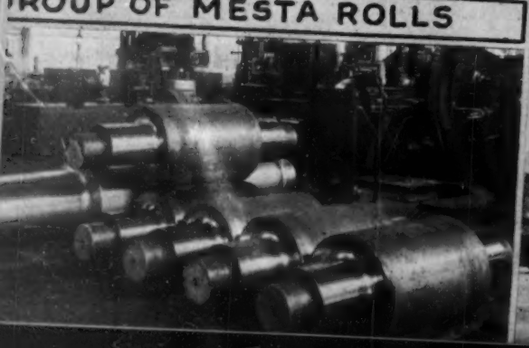
4" COLD STRIP MILL



38" HOT STRIP MILL

60" HOT STRIP MILL

ROUP OF MESTA ROLLS



BY MESTA

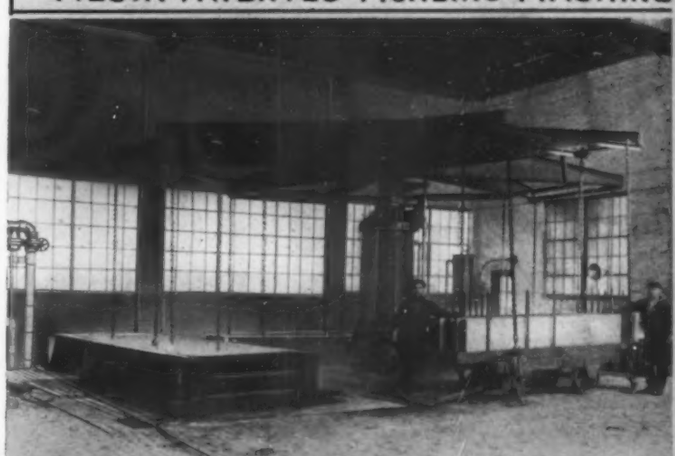
to meet the exacting demands of the Steel Industry in the production of strip and sheets. Mesta Four High Continuous Mills produce high quality strip of uniform gauge. Their successful operation in leading steel plants of the country is conclusive proof of their efficiency.

MESTA MACHINE CO.

PITTSBURGH, PA.

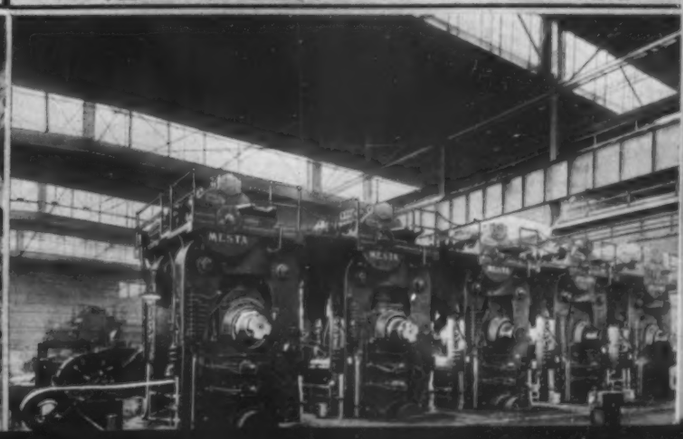
79" HOT STRIP MILL

MESTA PATENTED PICKLING MACHINE

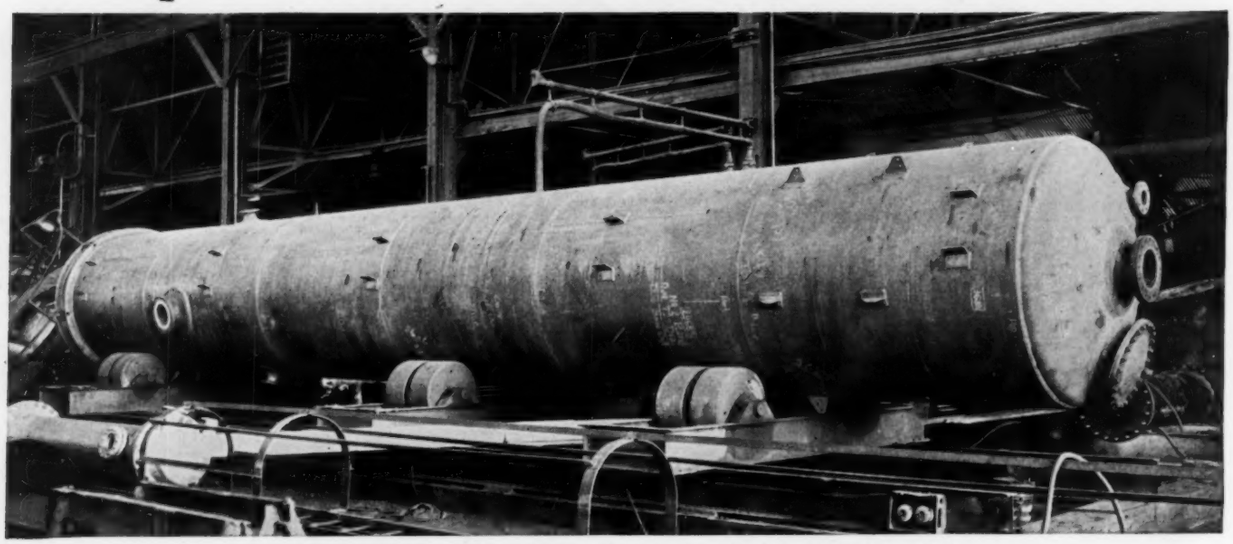


MESTA ROTARY FLYING SHEAR

42" TANDEM TIN PLATE MILL

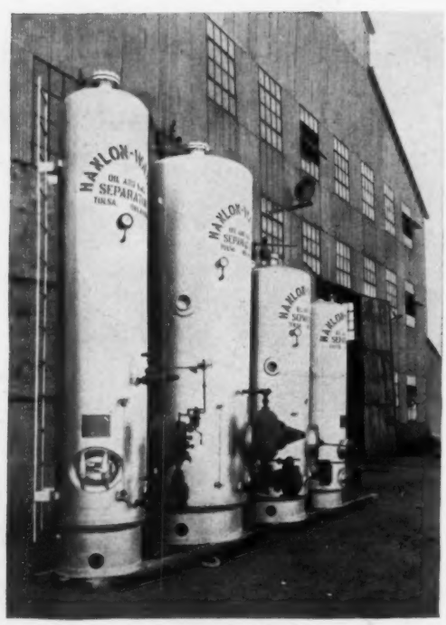


Where costs depend on... **Weld Soundness**



Welded bubble tower, 72 in. diameter. Photo courtesy Tulsa Boiler & Machinery Co.

MUREX assures economy



Four oil and gas separators of welded construction. Photo courtesy of Tulsa Boiler & Machinery Co.

Fabricators of petroleum refinery equipment save money by using Murex. In this type of work it pays to have welds right the first time. When poor seams do occur, they must be cut out, re-welded and re-X-rayed...an added expense that is avoided by the consistently sound deposits which Murex Electrodes provide.

The superior qualities of Murex Electrodes are due to their heavy, all mineral coating. This coating, which protects both arc and molten weld metal from the air, assures efficient operation and deposits of highest quality. Anchored to the core wire by a spiral asbestos winding, it is absolutely uniform in thickness and makes welding easier by having no thin spots to cause sputtering or wandering of the arc.

A comprehensive booklet, describing the full line of Murex Electrodes, the physical properties of Murex weld metals and other outstanding features, tells in more detail what Murex can do for you. May we send a copy?

• • •

METAL & THERMIT CORPORATION · 120 BROADWAY, NEW YORK, N.Y.

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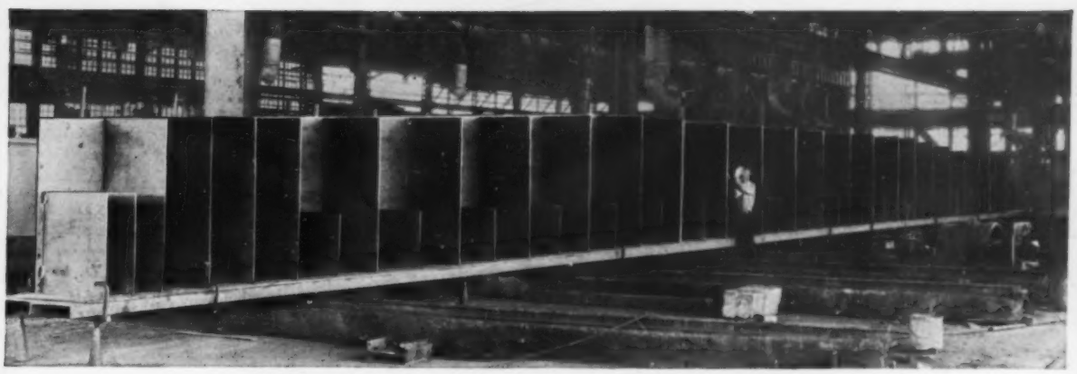
M U R E X

HEAVY MINERAL COATED ELECTRODES

BUILDERS OF STEEL MILL CRANES OF STEEL MILL STEEL



Welding of 100 foot girder for heavy duty steel mill Crane.

● To the best of our knowledge over 95% of the all welded box girder cranes in existence are CLEVELAND CRANES.

● In welding there is no substitute for experience.

5200 Cranes have been built by Cleveland in 35 years. This well fits us to meet your most exacting modernizing requirements.

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THE CLEVELAND CRANE & ENGINEERING CO.

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CLEVELAND CRANES

All Sizes for Every Service

Another BANTAM development

THE COMBINATION THREE ROW BEARING

Which Combines Straight Rollers For Their Load Carrying Capacity and Compactness With Tapered Rollers to Carry Thrust Load

This Bantam Heavy Duty Bearing is 26" bore x 42" O. D. x 25½" long. Due to the use of tapered rollers at the ends and a long row of straight rollers in the center this bearing combines the load carrying capacity and compactness of the straight roller with the thrust load carrying qualities of the tapered roller.

The cages of the three-row combination bearing are one piece lubricating type rigid bronze castings eliminating the weakness inherent in fabricated structures. Roller Pockets are shaped to facilitate the lubrication of the rollers and accurately machined pads contact the rollers to guide them at all times.

By the proper variation of the different elements a Bantam combination bearing may be built to carry desired combinations of radial and thrust loads.

Trade Mark Reg. U.S. Pat. Off.

BBB

THE BANTAM BALL BEARING CO.

SOUTH BEND, INDIANA

BOSTON CHICAGO YOUNGSTOWN DETROIT HOUSTON NEW YORK NEW ORLEANS
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ONE OR A MILLION • ½" TO 60"

SCHLOEMANN

OUR MOTOR-ROLLERS

eliminate mill table delays. They are entirely self-contained units, having a stationary shaft and a minimum number of wearing parts.

OUR HOLDING TABLE

a patented delay mechanism for cooling stock between roughing and finishing stands of strip mills, prevents curtailment of production.

OUR CATCHER TABLE

for sheet and tin plate assures increased production at low operating cost and low maintenance. Sheets remain flat without distorted ends.

OUR ROLLER-TYPE HOT BED

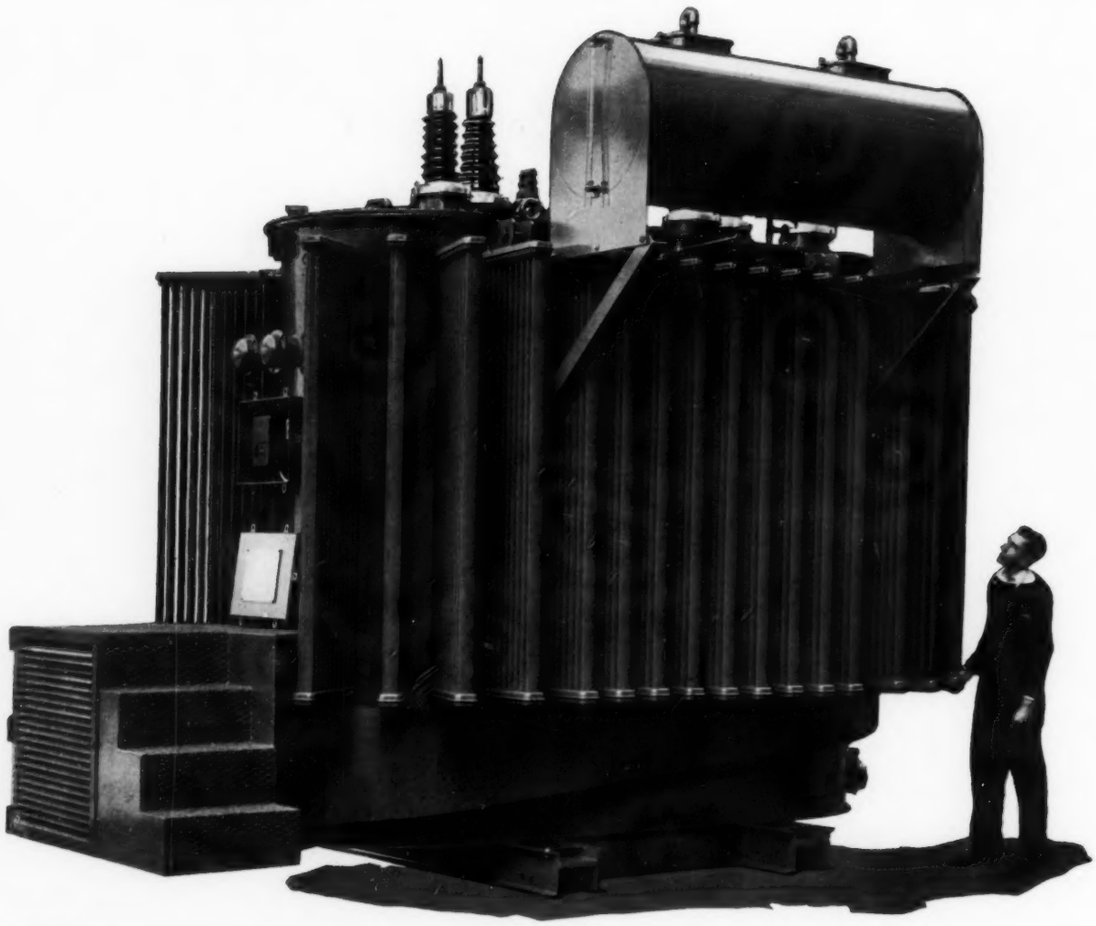
another feature of our special machinery for rolling mills, automatically operated, constitutes the most advanced and economical Hot-Bed System in regard to first cost, operating cost, and maintenance; uniformity of structure, and straightness of rolled stock.

OUR INDIVIDUAL SERVICE

is at your disposal. Approach us with your specific requirements and unsolved problems. Our experts will help you to find the best solution.

SCHLOEMANN ENGINEERING COMPANY
EMPIRE BUILDING **PITTSBURGH,** PENNSYLVANIA.
HYDRAULIC AND ROLLING MILL MACHINERY!

'Let Pennsylvania save you money!



THIS is a 3-phase 3-voltage Power Transformer of 15,000 KVA output, forced-air cooled. It was built and tested complete in our spacious new, modern plant, which is manned and equipped to produce as large or as small a transformer as the job may require.

Whether your need is for a standard or a special distribution or power transformer, put it up to Pennsylvania for an estimate.

We feel confident we can save you money as well as produce the most modern and efficient transformers for your particular requirements.

PENNSYLVANIA TRANSFORMER CO. - PITTSBURGH, PA.

[*Representatives in Principal Cities*]

PENNSYLVANIA TRANSFORMERS

DISTRIBUTION AND POWER

THE New Ohio Lifting Magnet and the new Controller will be shown with current on at the Iron and Steel Engineers Convention Exhibit in Booth No. 34.

They both present improvements well worth your investigation.

They have been on trial in hard, continuous mill service for three years so there is nothing experimental about them.

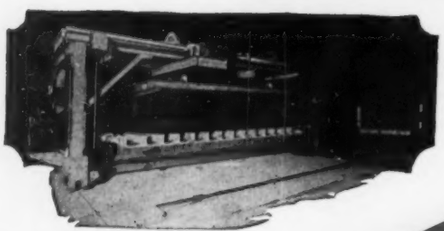
These improvements add materially to the useful life, capacity and efficiency of Ohio Magnets and Controllers.

Come and see them at Booth No. 34

The Ohio Electric Mfg. Co.

5907 MAURICE AVENUE - - - CLEVELAND, OHIO

BILLET HEATING
Showing four of a battery of six oil fired billet heating furnaces in a prominent steel plant.



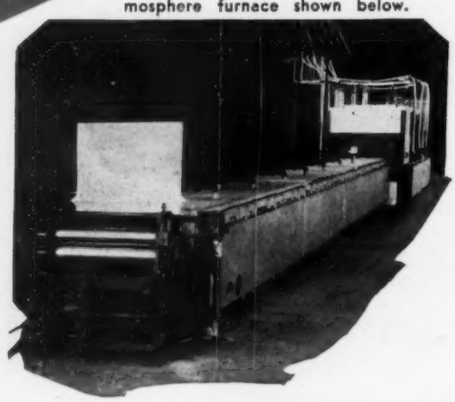
HEAT TREATING
An oil fired and two electric car type furnaces with crane and quench, used for normalizing, annealing and heat treating.

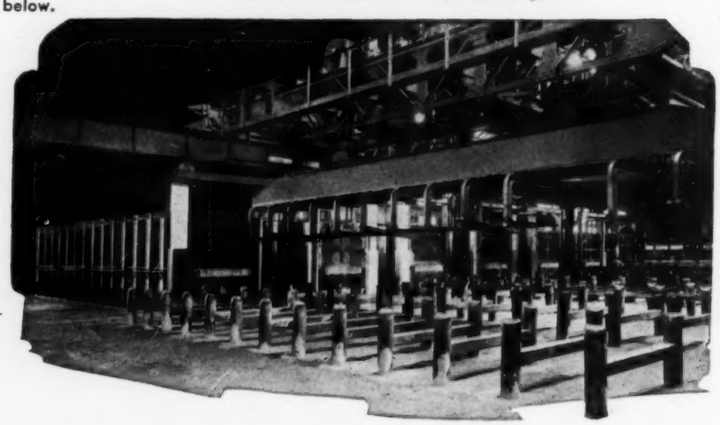
Fuel Fired and Electric Furnaces
BUILT FOR PROMINENT STEEL PLANTS
By
The Electric Furnace Co., Salem, Ohio

NORMALIZING
Two car type furnaces used for normalizing and annealing alloy steel in various shapes.

ANNEALING TUBING
Tubing up to 47 ft. long uniformly and economically annealed in the battery of seven gas fired furnaces shown below.

BRIGHT ANNEALING
Cold rolled steel strip bright annealed in continuous controlled atmosphere furnace shown below.





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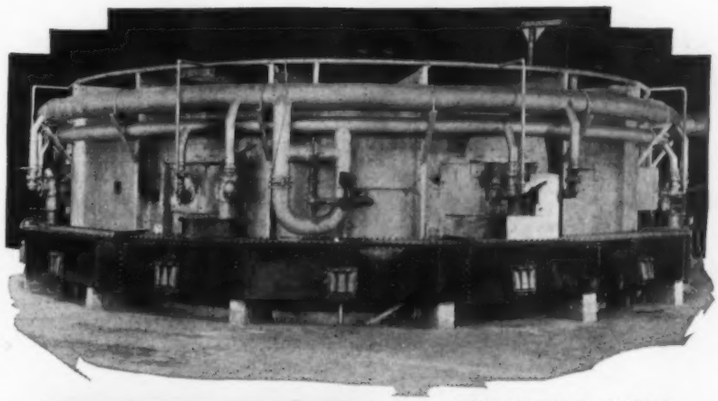
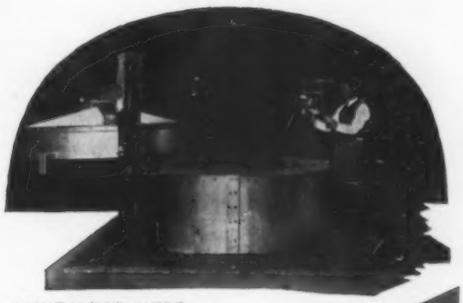
THE ELECTRIC FURNACE CO.
SALEM, OHIO.

Fuel Fired Furnaces

Electric Furnaces



NORMALIZING SHEETS
Gas fired rotary hearth type sheet normalizing furnace, capacity 6000 lbs. per hour.



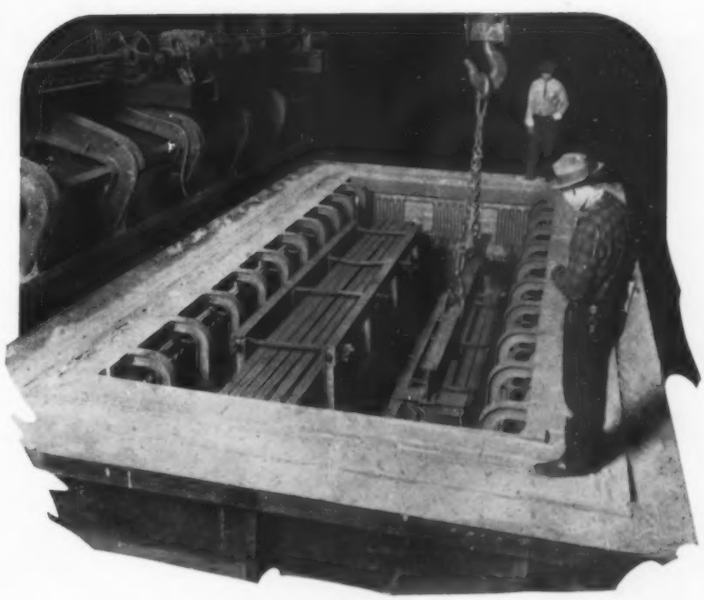
ANNEALING WIRE
One of several installations of pit type furnaces for annealing alloy wire in coils.

ANNEALING IN TUBES
Rectangular pit type furnaces used for annealing alloy steel in tubes.

Fuel Fired and Electric Furnaces
BUILT FOR PROMINENT STEEL PLANTS
By
The Electric Furnace Co., Salem, Ohio

ANNEALING BARS
One of a battery of five rectangular pit type furnaces used for annealing alloy steel tubes and bars.

ANNEALING RODS
An upright pit type furnace used for spheroidizing annealing alloy rods up to 27 ft. in length.



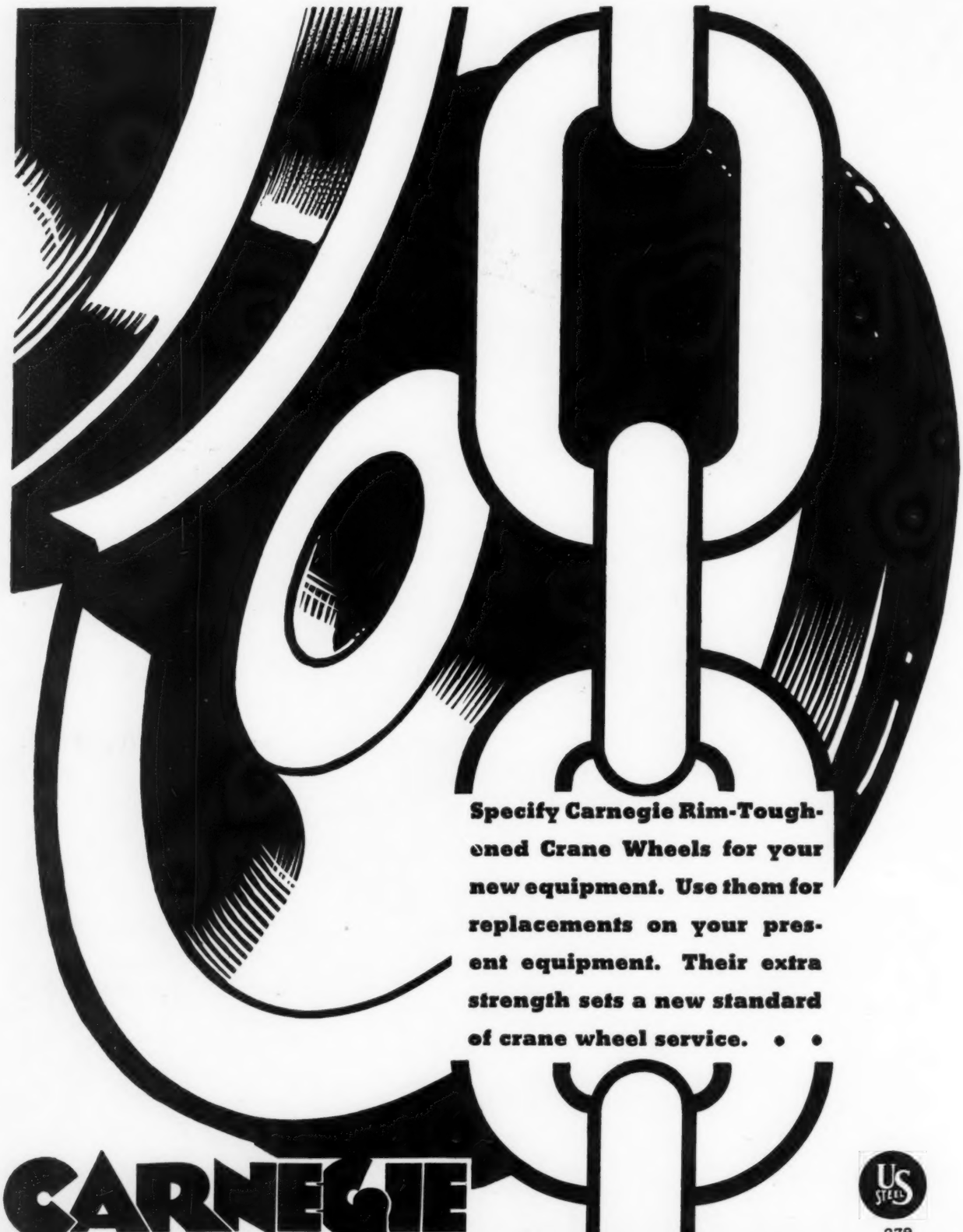
WE BUILD THE FURNACE TO FIT YOUR JOB — NO JOB TOO LARGE OR TOO UNUSUAL

THE ELECTRIC FURNACE CO.

SALEM, OHIO.

Fuel Fired Furnaces

Electric Furnaces



Specify Carnegie Rim-Toughened Crane Wheels for your new equipment. Use them for replacements on your present equipment. Their extra strength sets a new standard of crane wheel service. • •

CARNEGIE CRANE WHEELS

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Product of **CARNEGIE STEEL COMPANY** • *Subsidiary of United States Steel Corporation* • **PITTSBURGH, PA.**

A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

MAINTENANCE MEN

Specify Fast's Couplings

TO ATTAIN TROUBLE - FREE OPERATION

Your Purchasing Agent can buy you a coupling for less money but he can not obtain for you the same satisfactory, continual trouble-free service that is embodied in the design and manufacture of every FAST'S COUPLING.

THE BEST IS THE MOST ECONOMICAL

INSIST ON FAST'S—ACCEPT NO SUBSTITUTE

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The BARTLETT HAYWARD Co.

BALTIMORE MARYLAND

A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

BASOLIT
Pickling Tanks

Here is a Basolit Pickling Tank in action! The kind of action that demands a good tank. Low carbon strip steel travels continuously through this 240 foot tank filled with sulphuric acid and corrosive fumes. It is the kind of service Basolit Tanks are made for because they are leak-proof, wear-proof, and they resist all commercial acids.

This Basolit Pickling Tank was installed at the plant of The Otis Steel Company in Sept. 1932, and an average of 1600 tons of strip steel per week are pickled in it. In this period there have been no maintenance costs.

Otis has two other Basolit Pickling Tanks. The performance of the first one sold the other two. Why don't YOU consider the economy of pickling the Basolit way?

NUKEM PRODUCTS CORP., Buffalo, N.Y.

NEW YORK PITTSBURGH LOS ANGELES TORONTO, ONT.

You Can't Tell About an Egg by Looking at Its Shell

Any COOL magnet gives full lifting power. But heat is soon generated, and unless it is dissipated, lifting power declines . . . With lifting magnets as with eggs, the thing that counts is what's inside the shell. That decides whether the magnet will weaken as the day passes. C-H invites you to a convincing demonstration of what's inside the shell: Ask your nearest C-H Office to show you the cut-away coil.

Here you will see how the patented new C-H impregnating process does away with the old, simmering pitch insulation, replacing it with a non-melting, non-heat-retaining compound that makes the coil a solid, keeping it firmly anchored and providing a means for rapid heat conduction to the shell. In the shell design there are no spaces for heat entrapment.

And in the 2-position C-H Automatic Drop Control the current, usually left on during the return swing, is shut off. By this repeated current interruption, this cause of heating is eliminated. All of which adds up to "All-Day Superlift—Full Initial Power for the Last Load." Read the Red Top Supermagnet features. Call C-H when you want a rugged magnet with All-Day Superlift. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus*, 1257 St. Paul Ave., Milwaukee, Wis.

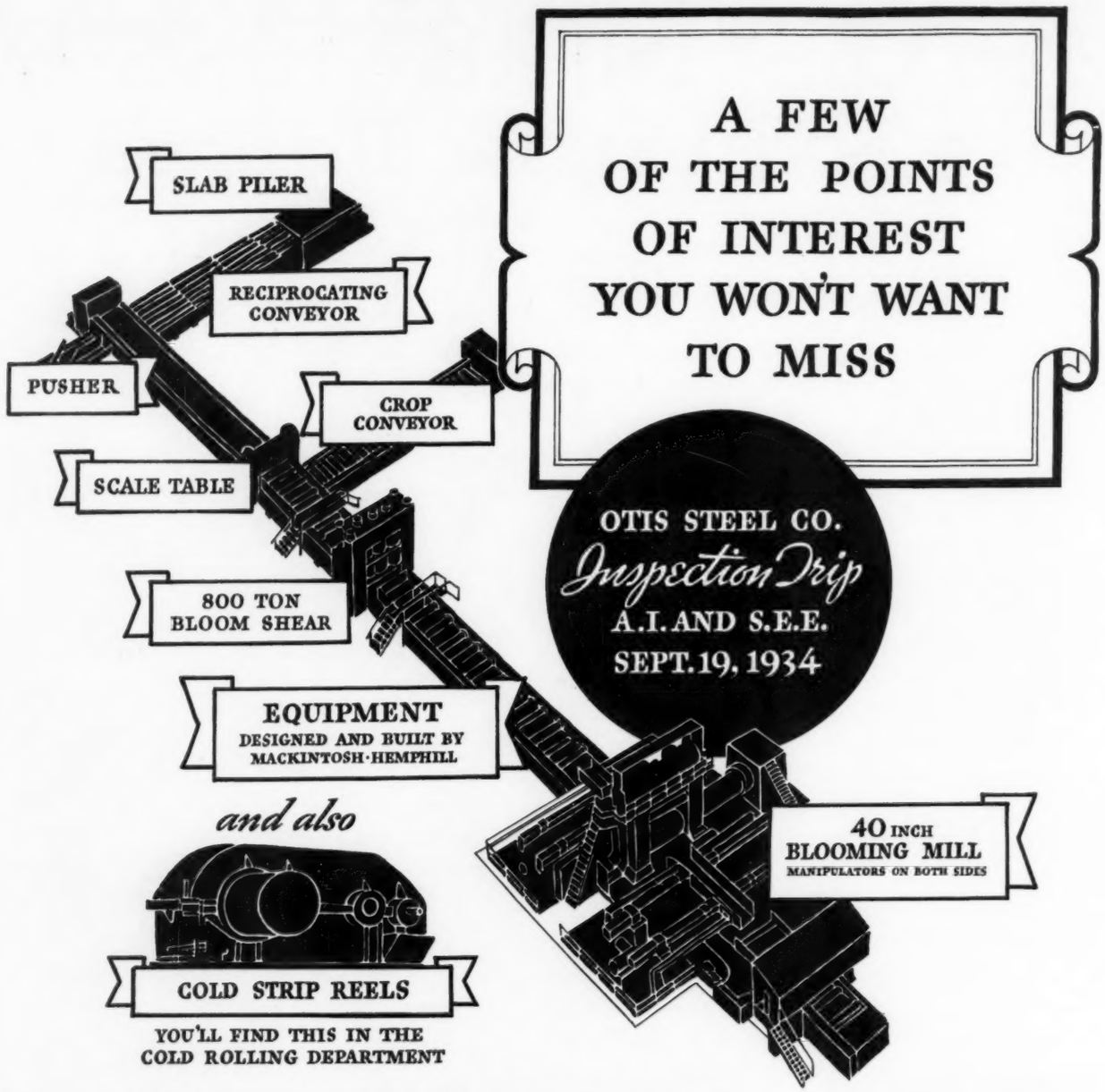
Why C-H Red Top Supermagnets Last Long, Stay Cooler, Lift More

1. Dynamo steel body—high permeability. Alloy steel outer shoe—excellent magnetic qualities; flanged, will not catch on gondola sills—readily replaced without dismantling.
2. Strap copper wound magnet coil, asbestos ribbon insulated. Wound on magnetic steel spool, increasing lift and eliminating waste space. Ebony asbestos wood protects bottom of coil.
3. Patented impregnating method uses non-melting, non-heat-retaining insulation instead of pitch, makes the coil a monolith. Permits permanent coil anchorage.
4. No air space inside for heat entrapment. Rapid conduction of heat to heat-dissipating body.
5. Ribbed manganese steel coil shield lasts as long as the magnet.
6. Shielded terminal box is in protected cavity. Cable connector stands more strain than cable itself, is weather-proof and self-locking, assuring perfect contact.
7. 2-position C-H Automatic Drop Controller gives snappy drop, shuts off current on return swing, thus reducing another cause of heating.

CUTLER C-H HAMMER

RED TOP SUPERMAGNETS

See Our Exhibit Booths 8 & 9
Iron & Steel Exposition—Cleveland—Sept. 18-19-20



The Mackintosh-Hemphill organization is proud to have played a part in making the Otis Steel Company plant one of the finest and most efficient in the country . . . . Among the equipment designed and built by Mackintosh-Hemphill is a complete 40" Blooming Mill which now furnishes slabs to the continuous strip mill. Manipulators on both entering and delivery sides permit the rolling of slabs, as well as blooms and billets. The Mill is served by an 800-ton Hydraulic Bloom Shear. Beyond is a Crop Conveyor and Scale Table; an Electric Pusher for pushing material off the Shear Run-out Table to the Reciprocating Conveyor; and a Piler. The Cold Strip Reels, in the Cold Rolling Department, are also of interest. Used for rolling soft fender stock, the minimum clearance between drum segments eliminates reel block marks, and produces a superior strip.

131 years of M-H experience is at your call, waiting to translate itself into new methods, new machinery, for all steel processing and finishing departments.

MAKES NO DIFFERENCE WHERE ANTI-FRICTION BEARINGS ARE USED

"It's a Safety Measure to Specify HYATTS"

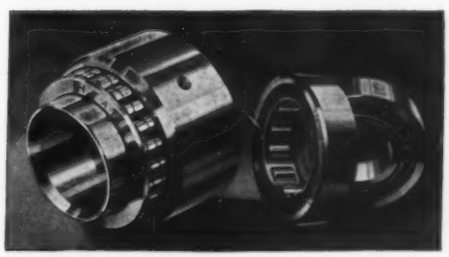
Armatures
Countershafts
Sprockets
Rockershafts
Idlers
Pinions
Axles
Trunnions
Camshafts
Lineshafts

Most machine and equipment builders know the truth of it. And users are realizing it more and more every day.

Thus, it's a safety measure to specify "Genuine Hyatts." You are taking advantage of more than 40 years of intensive experience and rich knowledge of progressive quality bearing manufacture. In short, you are putting the undisputed leadership and consumer acceptance of Hyatt back of your product.

Furthermore, you are assuring the users of your product of long, continued, dependable, trouble-free bearing performance. And they know it.

So, to say "Hyatt Roller Bearing Equipped" is but another way of saying, "This is a quality-built product." Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, Oakland.



Spindles
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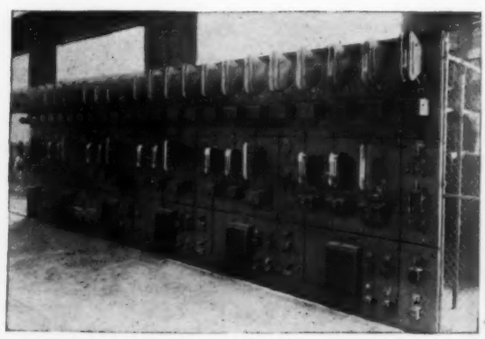
HYATT
ROLLER BEARINGS
PRODUCT OF GENERAL MOTORS

WHY Otis Steel Uses THEY "STAND THE GAFF"

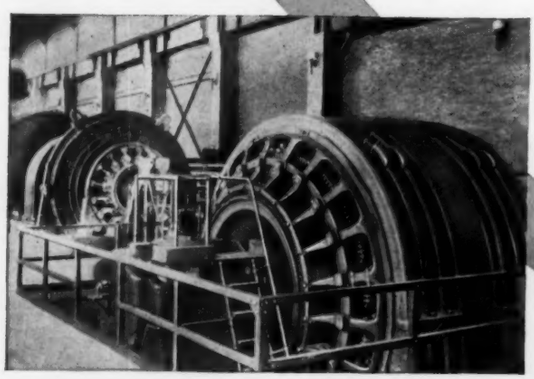
Follow the steps indicated by the arrow, from ingot to finished strip, when you visit this modern steel plant with the A. I. & S. E. E., and see these G-E drives.

AFTER obtaining as many as 18 years of satisfactory service from G-E equipments, the Otis Steel Company, in its extensive modernization program of 1931, installed G-E drives for its principal main rolls. Now, you can see Otis steel carried all the way from ingot to finished strip by G-E motors.

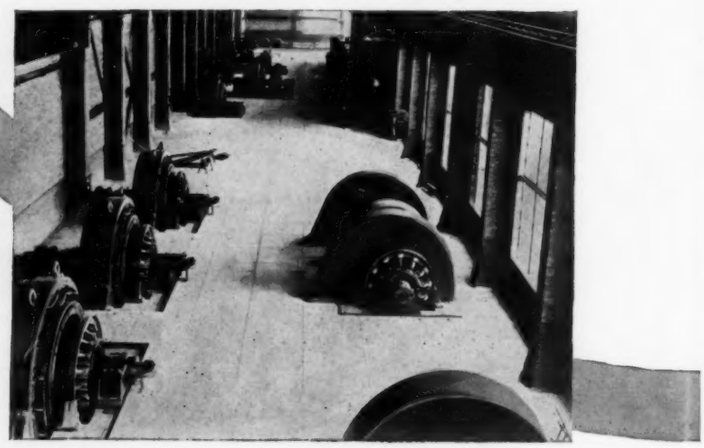
This 40-in. reversing blooming mill is equipped with G-E drive. Here the ingots are rolled into slabs to be fed into the hot-strip mills



These compact G-E panels provide magnetic control for the finishing stands of the 20-in. hot-strip mill



The blooming-mill drive consists of a 6500-hp., 50/120-rpm., G-E reversing motor with a 5600-kw. G-E flywheel-motor-generator set. This equipment has given reliable service for more than ten years



This is the motor room of the 72-in. continuous hot-strip mill, where fourteen G-E motors, totalling 24,700 hp., and two 4000-kw. G-E motor-generator sets are installed

G E N E R A L

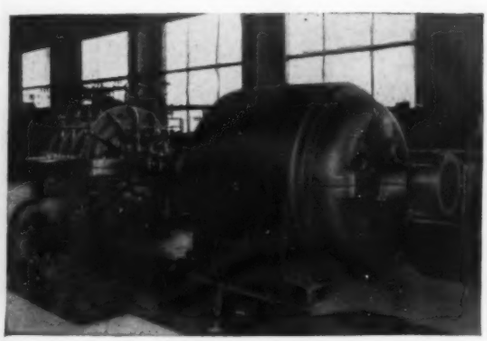
A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

General Electric Drives

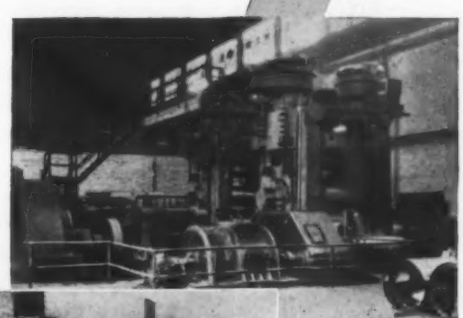
OF CONTINUOUS OPERATION

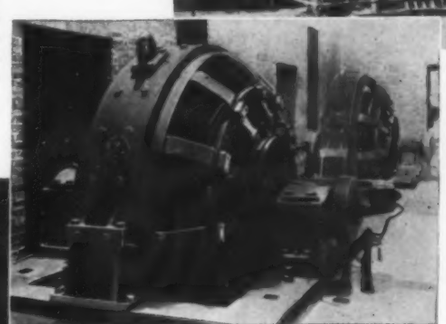
We invite you to visit our exhibit in Space 129 at the A. I. & S. E. E. convention, Cleveland Public Auditorium, September 18 to 20, inclusive

GENERAL ELECTRIC offers complete electric equipment for any steel-mill process — motors and control, transformers, switchgear, wire and cable — everything electric, backed by nation-wide service facilities. General Electric Company, Schenectady, N. Y. Sales Offices and Service Shops in all principal cities.

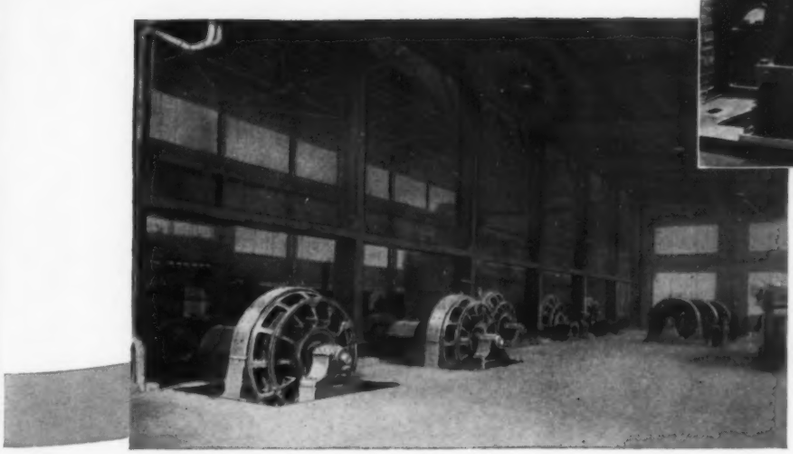


A G-E induction motor, rated 700 hp., 1500 rpm., 6600 volts, drives this centrifugal pump, which supplies water at high pressure for removing scale from the hot strip





Finished strip emerges from this 72-in. cold-strip mill and is wound on a reel driven by a 400-hp. G-E d-c. motor. G-E control automatically holds the strip tension constant



Two G-E motors, 1500 hp., 200/400 rpm., drive the 72-in. tandem cold-strip mill. These are the largest motors in use in this type of mill

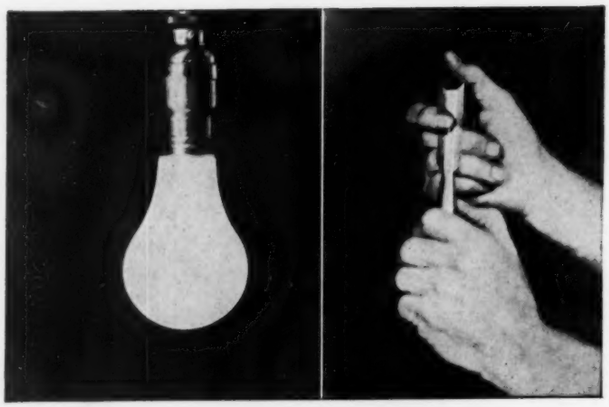
Seven G-E motors, totalling 11,700 hp., and three 1500-kw. G-E synchronous converters drive the 20-in. continuous hot-strip mill, one of the first ever equipped with individually driven stands. This equipment has given reliable service since its installation, in 1923

008-10

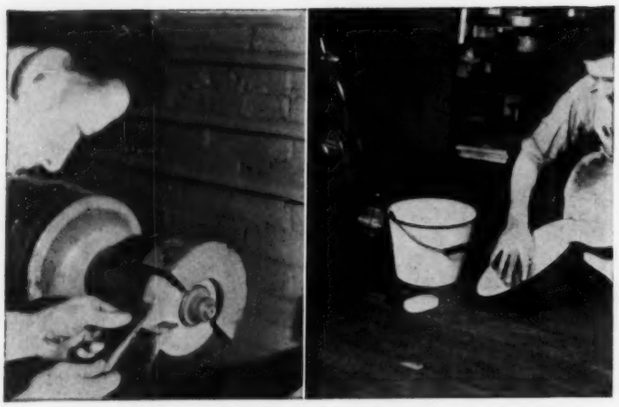
ELECTRIC

A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

GOOD LIGHT—LIKE GOOD TOOLS INSURES MORE AND BETTER WORK



A lamp is a tool just as a chisel



Cleaning your lighting equipment regularly is just as important as the sharpening of tools.

Light is a tool for seeing, and seeing enters into practically every physical and mental act in the productive process. Yet this basic tool of all industry is still so imperfectly understood that seven out of ten industrial establishments are failing to provide lighting that is adequate for efficient seeing.

Like all tools, lighting systems must be maintained in good shape if they are to serve effectively in the productive process. Glaring light sources, blackened lamps or dirty fixtures are like dull tools, inefficient and sometimes dangerous.

Every lighting system should be checked from time to time to assure eye comfort and efficient operation. This can be done easily with meters which accurately measure the quantity of light. Our engineers are equipped with these instruments and will be pleased to assist our customers with their plant lighting.

DUQUESNE LIGHT COMPANY

Call GRant 4300
Line 283

Send for your copy... THE MOST COMPLETE BOOK OF ITS KIND *Full of Helpful* ELECTRIC HEAT DATA

HEATING UNITS—Chromalox
CHROMALOX
THE RIGHT HEAT...WHEN AND WHERE YOU WANT IT
Manufactured Exclusively by EDWIN L. WIEGAND CO., Pittsburgh, Pa.
Electrically with CHROMALOX

60 *Pages Fully Illustrated*

Supplemented by Calculators, Charts, Curves, Diagrams and Tables for estimating heat requirements

IT TELLS YOU HOW TO INSTALL

—Heaters for Air or Space Heating
—Heaters for Heating Fluids, Compounds or Metals
—Heaters in Steam Boilers, Water Heaters, Steam Tables, etc.
—Cartridge Units in Oil Filters
—Strip Heaters to Oil Pipes
—Strip, Ring and Immersion Heaters to all kinds of Tanks, Vats, Containers, etc.
—Strip, Ring and Cartridge Units to Platens, Dies, Molds, etc.
—3-Heat Switches, Thermostatic Control, etc.

CONTAINS THE LARGEST VARIETY OF HEATING UNITS AVAILABLE —over 3000 items

388 Strip Heaters	117 Air Heaters
218 Ring Units	12 Unit Heaters
550 Immersion Htrs.	28 Air Blast Heaters
377 Cartridge Units	36 Oven Heaters
92 Hot Plates	78 "Finstrips"
14 Burning Brands	24 Rod Units

Also Range Units to fit all makes of ranges. Broiler Units, Heavy-Duty Range and Oven Units. Acquarium Heaters, Automobile Heaters, etc. 6 Types Temperature Control.

★

This covers only a part of the tremendous line of Chromalox heating units available for heat applications up to 1000 degrees F.—the result of 20 years of pioneering experience in the design and manufacture of refractory insulated heating units. This wide and varied experience has also equipped us adequately to produce Chromalox heaters in many special designs to handle your most unusual problems. Chromalox Heating Units, manufactured in the United States, Canada and England, have wide acceptance all over the globe.

Whether the heating job is large or small, whether heating compounds, metals, fluids or even some room or space where men and machines are working, or some product or process which should be modernized with electric heat—you will find the right answers and the necessary equipment recommended in this handy book.

More than a catalog, it instantly gives the detailed information you want when applying heat electrically. In it you will find dozens of different types of heating units in hundreds of various sizes—ready for immediate shipment.

It is an invaluable book for users of electric heat. Manufacturers and design engineers find it a helpful hand book. If you are making electrically heated appliances and equipment, or developing such products, you will find its data useful. Mail the coupon for your FREE copy.

MAIL COUPON *today*

MAIL WITH YOUR BUSINESS LETTERHEAD

Edwin L. Wiegand Co., 7545 Thomas Blvd., PITTSBURGH, PA.

Please send me, without obligation, a copy of the new 60-page Chromalox Catalog No. 34 of Electric Heating Data. I am particularly interested in equipment for heating.....

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Name..... Position.....

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CHROMALOX HEATING UNITS *Mfg. Excl. by* **EDWIN L. WIEGAND CO., PITTSBURGH, PA**

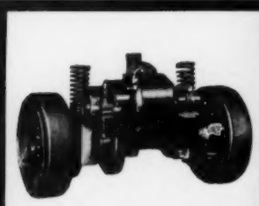
Announcing the Modern Line of

TRADE AUTOMATIC MARK TRUCKS

with all New Features

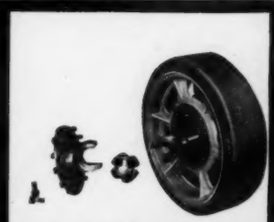
DRIVING UNIT

Double reduction spur gear type, insuring highest efficiency. Horizontally split housing. Independent knuckle yokes. Wheels and outer drive yokes Timken bearing equipped. Dual spring mounting. Steering arms bolted directly to drive knuckles. Inspection cover.



CONTROL SYSTEM

A large hinged cover readily exposes the entire electrical system for inspection. Full magnetic contactor operation provided on traction and lift switches. New segment mountings. Special interlock and safety switch features provided. Operating levers indexed for direction.

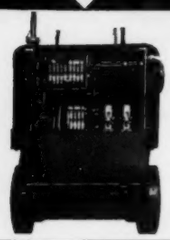


UNIVERSAL JOINTS AND DRIVE AXLES

Outer universal joints and drive plates are an integral forging. Drive axles full floating type with splined connections. Entire joint, ball and inner shaft assembly readily removable through wheel. New "V" type design used throughout, assuring 100% greater strength.

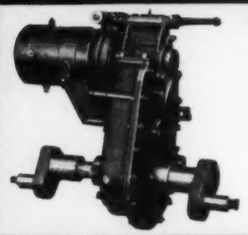
TRAILING WHEEL MOUNTING

Centered king pins with bearing mountings are incorporated first time in industrial trucks, which, together with mounting of driving wheel pins ¾" from exact center, assure ease of operation never before attainable. Shockless steering is also accomplished. This is an exclusive "Automatic" feature.



TRAILING AXLE

Of the fully compensating type, preventing strains being transmitted to frame. Trailing wheel bearings interchangeable with drive wheels. Steering arms of bolted on type fastened directly to knuckles. All steering connections mounted above axle affording maximum road clearance.



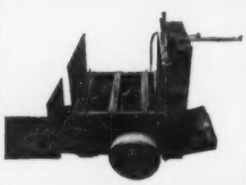
FRAME

Side members continuous steel formed bar 1¼" by 5½", mounted in rear to structural steel shapes, welded and hot riveted. Rear upright members 8". No castings used. Capable of withstanding severe overloads and impact strains.

Other Models of "AUTOMATIC" TRUCKS available for a wide variety of applications also have exclusive features.

ELEVATING UNIT

Triple reduction spur gear train mounted on radial ball bearings fully enclosed in oil. Splined shafts. Two piece housing. Motor saddle integral with case. Two crank arms provided to assure proper stability when raising platform.

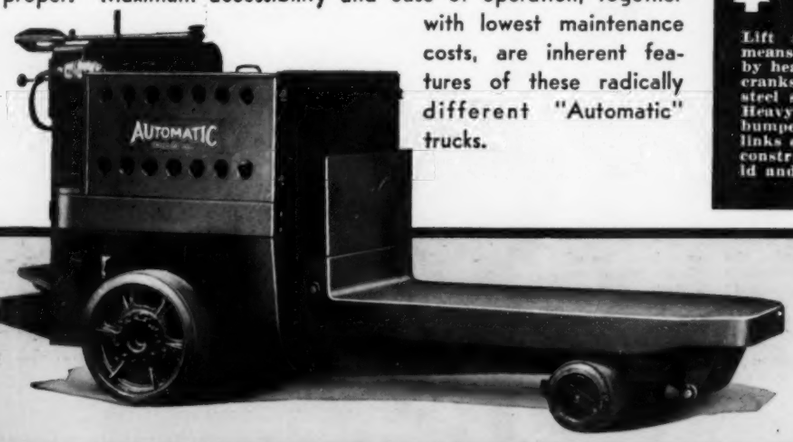


BATTERY BOX

Compartment designed integral with frame, using ¾" plates for top and sides. Battery removable top or sides. With battery removed immediate access to lift unit, steering connections, etc., is possible. Maximum battery space available.

A COMPLETE LINE

The features shown here apply principally to the "LN-3" truck illustrated. The same features follow generally throughout our entire new line of redesigned trucks for every industrial requirement. The new "Automatic" trucks are the most modern in the industry, incorporating features entirely new but which our years of experience have found to be proper. Maximum accessibility and ease of operation, together with lowest maintenance costs, are inherent features of these radically different "Automatic" trucks.



LOAD PLATFORM

Lift accomplished by means of links connected by heavy steel rods to lift cranks. Platform heavy steel structural shapes. Heavy cast steel front bumper. Front and rear links one piece wide hinge construction affording rigid and positive alignment.

THIS IS MODEL LN-3

Thoroughly redesigned and radically new model three ton low lift elevating platform truck. A rugged, flexible unit. All of the features shown on this page are included in this truck.

YOU ARE INVITED TO VISIT "AUTOMATIC" EXHIBIT, BOOTHS 108—118, IRON AND STEEL EXPOSITION

Scene in our designing room. These engineers contributed to the new "Automatic" designs. Each man is an expert in the application of material handling equipment. "Automatic" Production, Experimental, Electrical and Testing Departments have also been greatly increased in personnel.

Every "Automatic" Model is made with the latest modern equipment to insure quality.

40 EXPERIENCED ENGINEERS *designed these features for this New Line*

The combined knowledge and ability of forty engineers was employed in our broad modernization program to get new and advanced operating features that would mean a real contribution to industry. Their efforts extended through a long period of time, entailing much research and testing, so that every part of each truck would represent the utmost in today's engineering. Old patterns were discarded. New materials were secured and, to carry through the great design accomplishments of these experts, our facilities were modernized throughout.

IMPORTANT FACTS *for all of Industry*

"Automatic" Trucks have been manufactured for a longer period of time than any other make. Through the years "Automatic" advanced the important features of this type of equipment.

Under progressive and stable new ownership the modernization program, which now means so much to industry, has been put into effect. Again "Automatic" takes its place of leadership. Again industry can depend on "Automatic" to furnish the proper equipment for the most difficult material handling operations.

Trucks, tractors, cranes or trucks of special design built for greater efficiency and lower operating costs than any previous type are available for your service. This progressive organization is ready to serve you in true 1934 spirit.

AUTOMATIC *is your Economical Truck*

Greater speed, highest efficiency, lowest costs—now attainable in your Transportation Department with "Automatic" trucks. Displace obsolete trucks with modern units that fulfill every expectation. You can hardly afford not to investigate the possibilities of "Automatic" trucks, considering today's necessity for increasing earnings.

There is an "Automatic" truck to solve every intra-plant transportation and material handling problem.

AUTOMATIC TRANSPORTATION COMPANY

DIVISION OF THE YALE & TOWNE MANUFACTURING CO.

47 WEST 87th STREET CHICAGO, ILLINOIS

Send for Bulletin

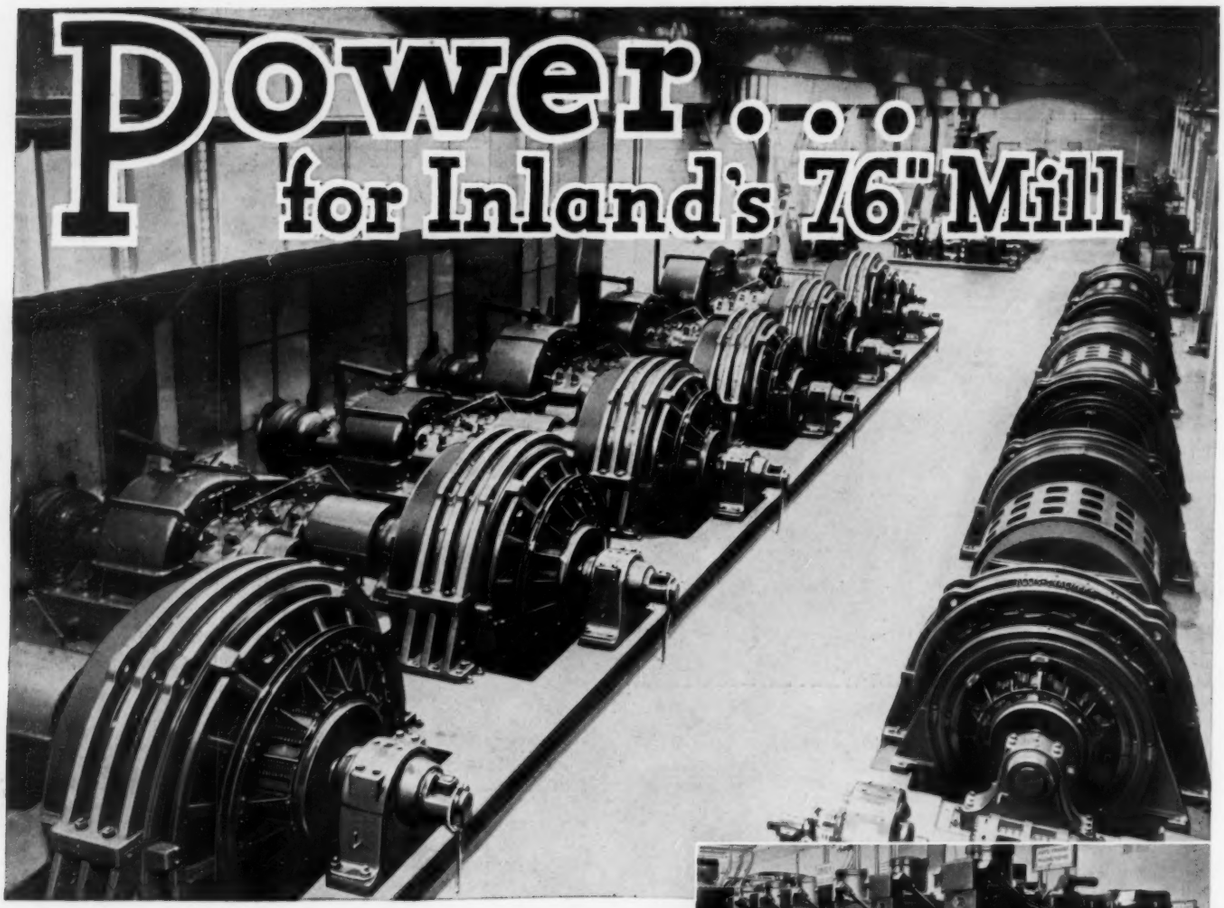
TRADE **AUTOMATIC** MARK

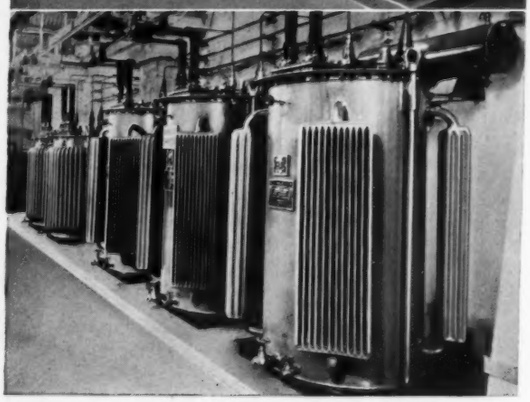
Elevating Platform Trucks. High Lift Trucks. Telescopic Trucks. Tilting Fork Trucks. Tractors. Locomotive Crane Trucks. Die Handlers. Ram Trucks. Bosh Trucks. Roll Handlers. Locomotives. Rest Handlers. Furnace Chargers. Load Platform Trucks. Baggage Trucks. Sheet Handlers. Container Trucks. Special Crane Trucks. Sugar Crushers. Tin Plate Trucks.

Available in capacities up to 50 Tons.

YOU ARE INVITED TO VISIT "AUTOMATIC" EXHIBIT, BOOTHS 108—118, IRON AND STEEL EXPOSITION

Power . . . for Inland's 76" Mill





Dependable Power Equipment

WHEN rolling strip, sheet or plate to accurate gauge it is necessary to shut down at regular intervals to change the working rolls, but, continuous service should be demanded of the power equipment.

The six 3500-hp, 600-volt, 175/350-rpm finishing stand motors, 500-hp scale breaker motor and the six supporting 2500-kw, 600-volt synchronous motor driven generators shown above have "Frog-leg" type armature windings providing 100% cross connection. In operation over two years carrying peak loads ranging up to 12,000-amperes (approximately 2-1/2 times normal rated motor current) on the last stands, no interruptions have occurred due to commutation troubles or flash-overs.

The transformers shown at the right furnish continuous service for mill auxiliaries and lighting.

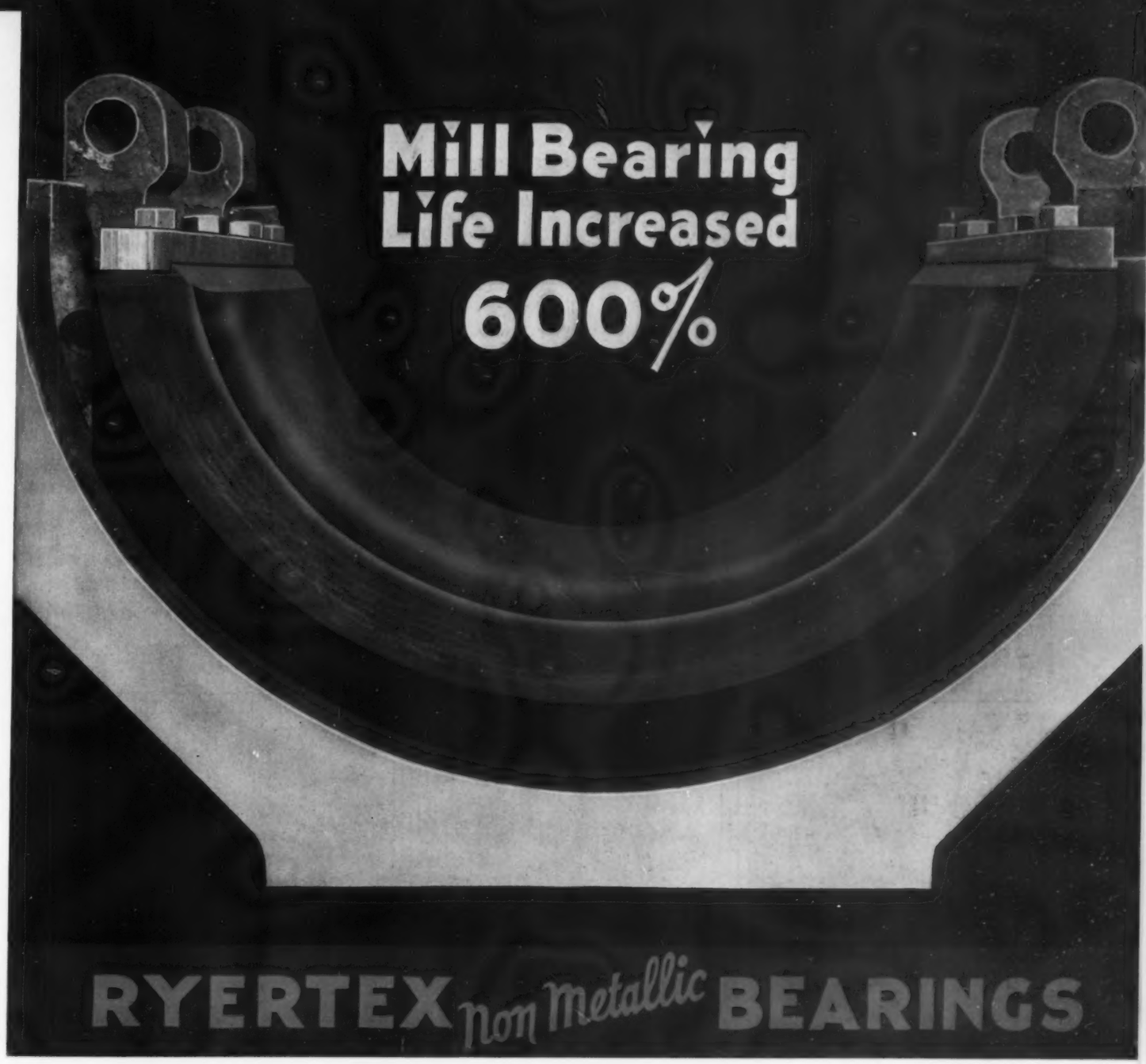
Starting and running oil circuit breakers are of the compact, safety type, Allis-Chalmers Reyrolle metal-clad construction. The running breakers illustrated are rated 700-ampere, 15,000-volts, with circuit interrupting capacity of 250,000-kva.

Allis-Chalmers engineers have solved many electrical problems introduced by recent developments in operation of rolling mills of all types. You are invited to submit your problem to them for the proper solution.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee

A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY



Long Bearing Life---

On a 36" blooming mill, 124,957 tons were rolled with only 1/32" wear on the Ryertex Bearings. Ryertex bearings on a 44" slab mill rolled 204,000 tons. Other applications indicate Ryertex bearings will last 4 to 10 times longer than bronze or babbitt installations.

Power Savings---

A blooming mill (36") saved 22% or about $10,000 a year on power alone when Ryertex Bearings were installed; a rod mill (12") saves 35% on power; a continuous mill (10") saves 17 to 25% depending on the sections rolled. 15% to 40% power saving can be expected when Ryertex Bearings are installed.

Grease and Oil Saving---

Grease and oil and their attendant labor are eliminated. Water is the best lubricant for Ryertex.

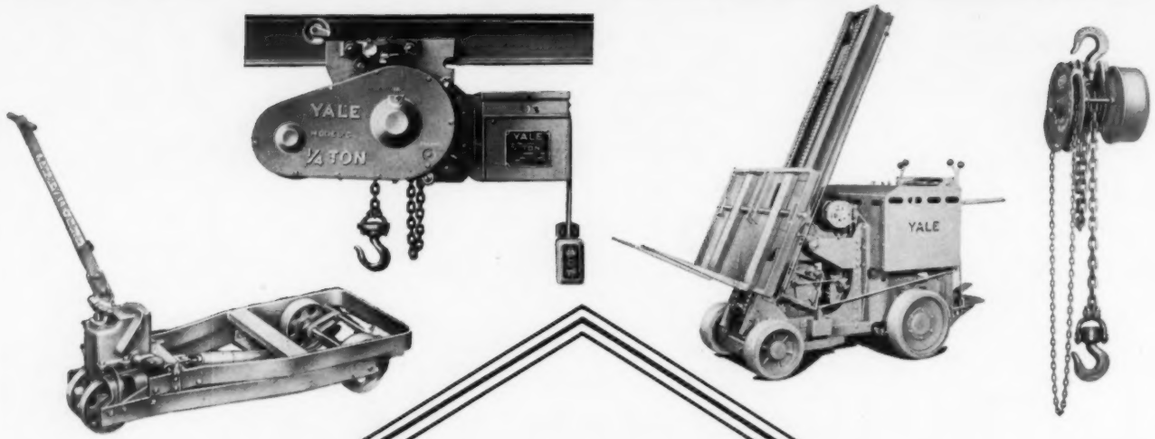
Summed Up---

Savings of more than $25,000 a year per mill are being recorded on present Ryertex installations. Less frequent roll adjustments; power, grease, labor, bearing cost—all show reductions in cost. Check up on these strong resin-textile bearings. Available in any size up to 30 inches. Write for complete data. Ask for Bulletin 32 A.

Joseph T. Ryerson & Son, Inc., Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON

YALE . . The Name to Remember—When the Plant Problem is—HAULING or LIFTING!



WELCOME!

We look forward to greeting you at the Public Auditorium, Cleveland, Ohio, September 18th to 20th.

We extend our cordial invitation to visit Yale & Towne Booths 60 and 66 where YALE Products, which have long served the metal working industry, will be on display.

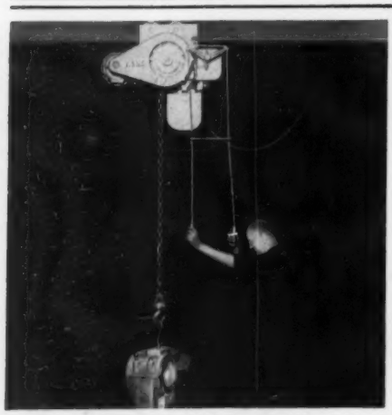
TRADE YALE MARK

THE YALE & TOWNE MFG. CO.

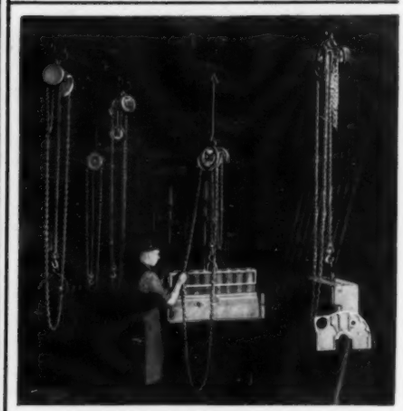
Philadelphia Division

PHILADELPHIA, PENNA. U. S. A.

Makers of Yale Electric Trucks, Hand-Lift Trucks, Hand Chain Hoists, Electric Hoists and Trolleys.

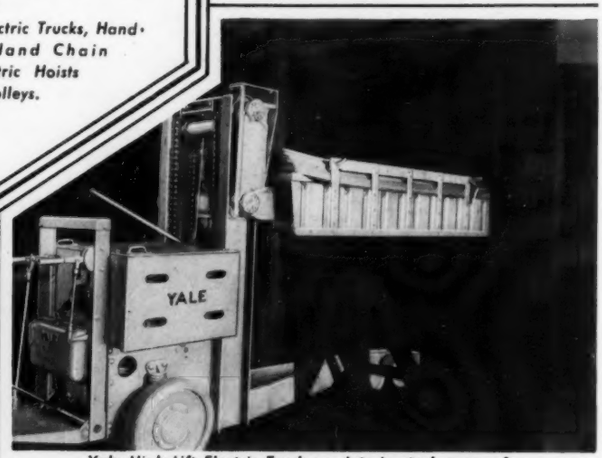


Yale Electric Hoist Speeds up handling operation and effects economies in Machine Tool Plant.



Yale Spur Geared Hoists handling cylinder blocks at the Spindle Boring Machine in Automobile Plant.

Yale Hand Lift Truck and Platforms, in service in Wire Product Plant eliminates many handling operations.



Yale High Lift Electric Truck on duty in stock room of Steel Warehouse, cutting the handling operations to a minimum.

GREDAG Lubrication

REG U. S. PAT OFF

SAVES $500.00 PER YEAR

in lubrication, power and maintenance costs on large mill drive

Gredag Lubricants afford proportionate economies in lubrication and operating costs on all types of mill and factory equipment.

Let us demonstrate the economies of

GREDAG

REG U. S. PAT OFF

INSURED LUBRICATION

For BEARINGS · SPEED REDUCERS
GEARS · CHAINS · SPROCKETS
CABLES · PLUNGERS · GUIDES
AUTOMOTIVE EQUIPMENT

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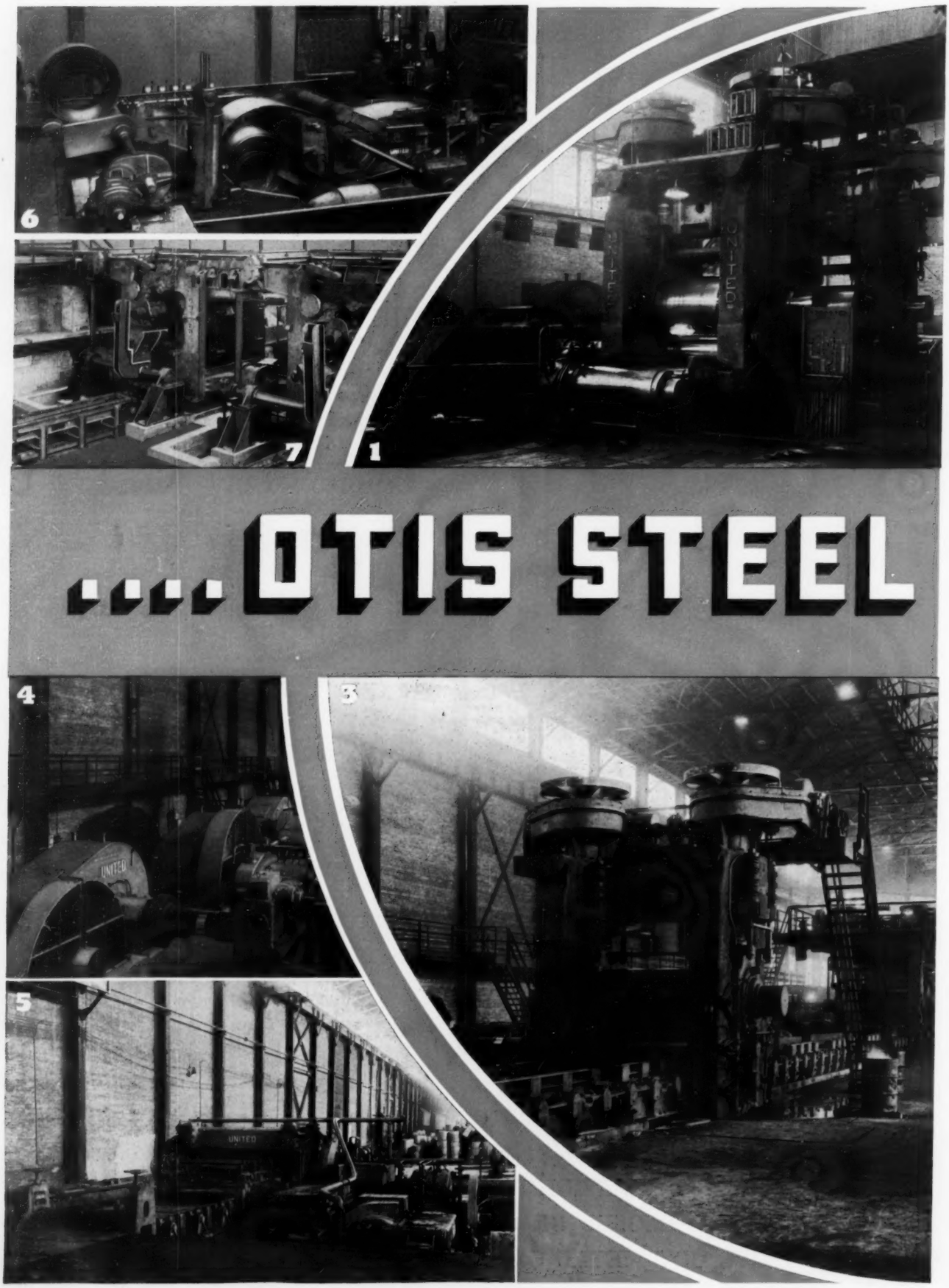
STEEL MILL HOT METAL CAR JOURNALS 20

A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY



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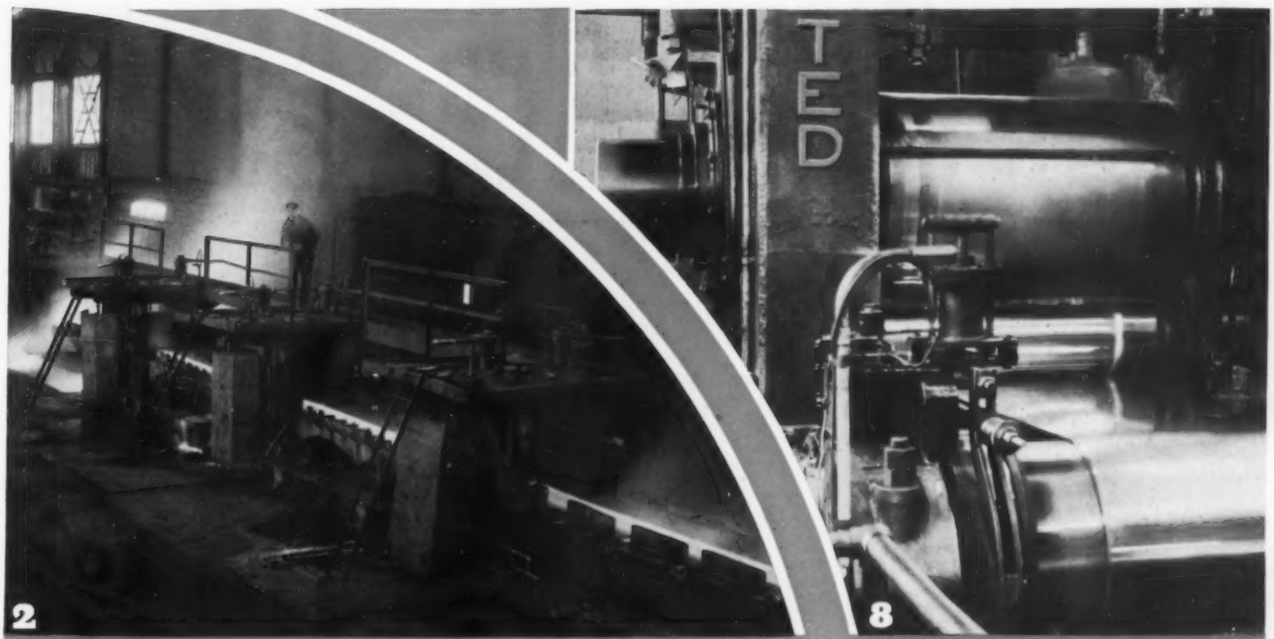


COMPANY MILLS

Designed and Built by

UNITED

ENGINEERING and FOUNDRY COMPANY

PITTSBURGH.....PENNSYLVANIA.

1. 20½" and 52" x 72" 2-Stand Tandem Cold Strip Mill. Complete installation with uncoiler, mechanical sticker, guide equipment, heavy duty reel and flying shear.

2. 20" 2-High Continuous Hot Strip Mill. Complete with edgers, hot bed, hot strip reels and flying shear.

3. 72" 4-High Continuous Hot Strip Mill. For producing wide strip in thin gauges at high delivery speeds. Complete installation with automatic reels, flying shear, etc.

4. Gear Drives and Pinion Stand for 72" Continuous Hot Strip Mill.

5. Flying Shear for cutting strip up to 66" wide in lengths ranging from 5 to 20 feet with a tolerance of plus or minus 1/16" from 5 to 10 feet.

6. Magnetic Uncoiler at 72" Cold Strip Mill for the mechanical opening of coils 66" wide, 48" diameter.

7. Automatic Hot Strip Reels at 72" Continuous Hot Strip Mill with capacity for strips up to 66" wide. Individual motor driven rollers.

8. Heavy Duty Reel at 72" Cold Strip Mill with outboard bearing and automatic stripper. Capacity strips up to 72" wide. Tension up to 100,000 lbs.

LINCOLN "SHIELD-ARC" WELDER BOOSTS USE OF ROLLED STEEL

Photo courtesy of Wellman Engineering Co., Cleveland, O.

The outstanding economies effected by use of Lincoln *"Shield-Arc"* welders are influencing more and more machinery builders to change to rolled steel construction. With the *"Shield-Arc,"* machinery builders, and steel men too, get better welds, faster welding and lower costs.

For example, *"Shield-Arc's"* uniform current allows you to use a higher average current with less splattering and waste of molten electrode metal. Thus with a *"Shield-Arc"* more weld metal is deposited per unit of time . . . in terms of your pocketbook, more weld per dollar.

More welding per kilowatt-hour is the result of *"Shield-Arc's"* high efficiency. *"Shield-Arc"* consumes less power regardless of load. Costs less to operate.

Maintenance, another contributor to welding costs, is practically eliminated in the *"Shield-Arc."* For example, its sparkless commutation makes brushes wear longer—keeps commutator surface smooth—causes no interference in welding circuits.

Eight other features help the *"Shield-Arc"* to produce high quality welds at lowest cost. In no other welder will you find *all* these features. That's why more Lincoln welders are in use today than any other make.

With new high capacity *"Shield-Arcs"* you can use ***larger size*** electrodes. Jumping only one size often saves 10 to 25 per cent in welding costs! And with any electrode you get guaranteed greater speeds with *"Shield-Arcs."* Start saving now. Ask for a free study of your welding costs. The Lincoln Electric Company, Cleveland, Ohio. Largest Manufacturers of Arc Welding Equipment in the World.

P. S. While in Cleveland for the Iron & Steel Exposition don't fail to visit our plant. We may show you something new in welding.

TO BE MODERN . . . A WELDER MUST HAVE THESE FEATURES

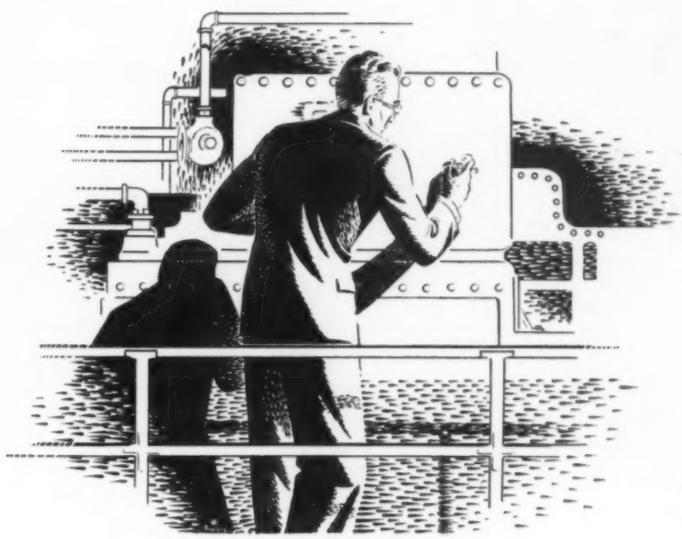
1. Uniform Current
2. High K. W. Capacity
3. Sparkless Commutation
4. High Efficiency
5. Remote Control (without portable accessories)
6. Polarity Switch
7. Center Reading Meter
8. Dual Control
9. Laminated Magnetic Circuit
10. "Handy Height" Controls
11. Drip Proof, Welded Steel Construction

"SHIELD-ARC" has them all

W-80

LINCOLN "SHIELD-ARC" WELDERS

A PROCESS THAT YOU WILL WANT TO KNOW ABOUT . . .



OUR ENGINEERS HAVE DEVELOPED A METHOD OF DETECTING MINUTE FLAWS IN SOME METALS.

WE WILL GLADLY EXPLAIN THIS PROCESS UPON REQUEST.

Address communications to

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WEST PENN POWER COMPANY

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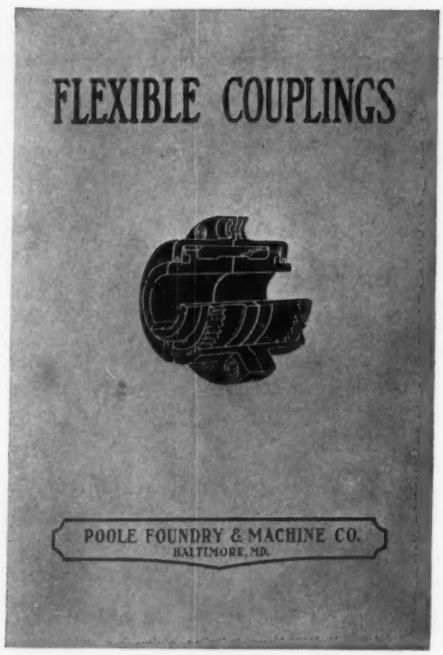
POOLE

FLEXIBLE COUPLINGS



HERE'S THE MOST COMPLETE CATALOG EVER PUBLISHED ON FLEXIBLE SHAFT COUPLINGS.

The latest issue of our flexible coupling catalog is not the first we have published, but our latest issue is much more comprehensive and contains data and information not heretofore published.

There are 72 pages; each page full with just the kind of information that actual and prospective users of flexible couplings will find most useful. All kinds and types are illustrated, complete with h.p. ratings, maximum speeds, dimensions, weights, etc. And in addition, the details of unusual designs and types of flexible couplings never listed before.

SEND FOR YOUR COPY TODAY.

THE POOLE FLEXIBLE COUPLING

Absolutely exclusive and different features, lubricated and dust proof.

Eliminate your shaft troubles for all time with POOLE FLEXIBLE COUPLINGS. Allow each shaft to float freely regardless of unavoidable errors in alignment.

POOLE FOUNDRY & MACHINE CO.

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G. H. Bales,
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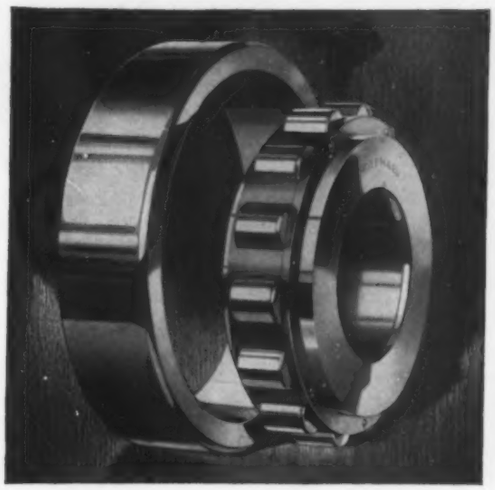
Reitz Sales Co.,
549 W. Washington St.

WHERE *no other type of bearing* WILL STAND UP



PARALLEL LINE CONTACT

Solid cylindrical rollers between cylindrical races providing maximum load contact area, increased steady load capacity, and a larger shock-absorbing capacity than any other type of single-row bearing.

SAFETY FACTOR

A margin ample for temporary overloads up to 50% beyond normal rating, as under peak loads, in unusually severe duty, or under shock conditions.

SUPERIOR CAGE

Made of extruded bronze to secure maximum density and uniformity—machined all over for balance—riding on inner ring lands or shoulders, relieving the rolling elements of its weight.

EXTREME ACCURACY

Rollers held to .0001 inch on diameter and to .0002 inch on length, throughout—absolutely true rolling surfaces, ends absolutely square with the sides—highly finished, quiet, friction-free.

DURABILITY

Uniform contact throughout the length of the rollers, providing the most efficient load distribution—greater wear-resisting surfaces—true rolling between all load contact areas—minimum friction between roller and cage.

SPEED QUALITIES

A lower friction coefficient under heavy load than any other type of bearing—a speed ability equal to that of any ball bearing, size for size, up to 35,000 R.P.M.

•

There's no duty too hard for a PRECISION Roller Bearing. And, for the less exacting duties, there are PRECISION Ball and Thrust Bearings. Write for the Catalogs—or ask our engineers for suggestions.

Because of Extreme Load Conditions, Use

PRECISION ROLLER BEARINGS

With the Heavy Bronze Cage

Picture to yourself the most difficult load conditions a bearing can be called upon to meet—high speed, heavy load, temporary overloads, shock, vibration. Then read, in the adjoining column, how NORMA-HOFFMANN Precision Roller Bearings—time-tested heavy-duty units—meet these conditions.

• • •

And remember—PRECISION Roller Bearings interchange in size with all standard ball bearings. They can be had—in addition to the standard type here illustrated—in one-lip, two-lip (self-contained), full roller type (without cage), self-aligning and adapter types.

SEE OUR EXHIBIT IN BOOTH No. 36, IRON AND STEEL EXPOSITION, AT CLEVELAND.

"NORMA-HOFFMANN"

PRECISION BEARINGS

BALL, ROLLER AND THRUST

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.

The Home of

TIME-CURRENT CONTROL

•

THE WRIGHT DYNAMIC LOWERING CIRCUIT
Controller for Crane Hoists

•

The EC&M Automatic Preset Screwdown Control

•

EC&M AUTOMATIC-DISCHARGE MAGNET CONTROLLER
and
Many other Developments of Outstanding Importance to The Iron & Steel Industry

THIS YEAR at the Iron & Steel Convention, you will have the opportunity of examining any one or all of the many EC&M developments brought out during recent years that have meant much to the advancement of the art of making steel.

During this 3-day convention, plan to examine in operation and secure complete information on any of the following systems of control that will modernize your present equipment and place you in a position to handle the increased volume of business which everyone is looking forward to in 1935.

Improve Lifting Magnet Operation

Do not penalize your lifting magnets with scattered discharges of the load. This wastes power and slows up the operation of your magnets. The EC&M Automatic-Discharge Magnet Controller not only insures a quick, clean release of the load on the magnet, but also prevents current flowing through the magnet for a longer time than is necessary. With one of these better control devices, an operator can make ***more lifts per hour*** and ***the magnet will operate much cooler*** in all-day service.

THE ELECTRIC CONTROLLER

WELCOMES YOU TO

THE IRON & STEEL EXPOSITION

at

CLEVELAND PUBLIC AUDITORIUM ***SEPT. 18 - 19 - 20***

REVAMP YOUR CRANES

It is no longer necessary to tolerate slow speeds when lowering light loads or the empty hook, nor is it necessary to sacrifice simplicity in control apparatus to get high light load lowering speeds.

The Wright Dynamic Lowering Circuit Controller for electric crane hoists inherently permits lowering the empty hook almost as fast as when lowering full load. The speed curve from no load to full load on the hook is almost a straight line. This greatly advanced control circuit has established a new kind of crane performance by which high speed lowering connections are provided with perfect safety yet without the addition of extra relays, contactors or resistor banks.

Many crane owners throughout every iron and steel center have benefited greatly by the ***More Trips per Minute with Less Power Consumption*** afforded by the EC&M Wright Dynamic Lowering Circuit Magnetic Hoist Controller.

BETTER STEEL FROM INGOTS

By accurately controlling Blooming Mill Screwdown Adjustments to the Exact specifications of the Mill Superintendent or the Metallurgist through the medium of the EC&M Automatic Pre-Set Screwdown Control, the quality of the steel produced can be materially improved.

This control is entirely automatic, yet in case of a cobble or any other emergency condition, the operator has instantly available full hand control in the usual manner. This equipment has been worked out to meet the requirements of almost any type of mill. The set-up is not limited to one rolling schedule; as many rolling schedules as desired can be provided for and set up at the same time. Ask for a demonstration of this development of major importance to the steel industry.

VISIT BOOTH NOS. 44 & 54

A hearty welcome awaits you. Here you will see many of the numerous sturdily constructed control accessories for which EC&M is noted and which are of utmost importance to the successful operation of every installation. Those in charge of the Booth will gladly make arrangements to show you in operation any of the several EC&M Developments that will produce higher efficiency and lower operating costs for you in 1935.

ON THE INSPECTION TRIP

Take a moment, please, to examine the EC&M TIME-CURRENT CONTROLLERS in operation in this plant.

The view to the right shows only a few of these modern controllers used in connection with the 20" Mill. In the control room for the 72" Mill will be found many more which employ the Time-Current Method of Acceleration.

AND MANUFACTURING CO.

IT IS THE "TOOL STEEL" THAT MAKES THE

GEARS PINIONS

CRANE WHEELS—TAPER OR STRAIGHT TREAD

BRAKE WHEELS SHEAVE WHEEL PINS

ROLLS
Leveller, Coil, Pinch, Straightener, Etc.

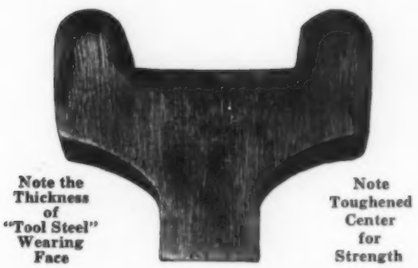
COUPLING BOXES SPINDLES

SCREW DOWN SCREWS AND NUTS

Longer life—usually many times longer—means reduced maintainance costs, both for material and installation labor.

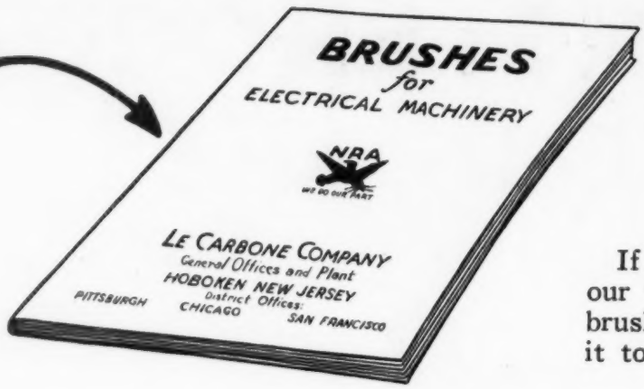
A. I. & S. E. E.—TWENTY-SEVEN YEARS OF ENGINEERING SERVICE TO THE IRON & STEEL INDUSTRY

HARDENING PROCESS DIFFERENCE IN LIFE



—Ask your friends their experiences with "Tool Steel" products.

SATISFIED USERS ARE OUR BEST SALESMEN



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If you did not receive your copy of our very comprehensive write up on brushes we shall be very glad to mail it to you on receipt of your request.

LE CARBONE BRUSHES ARE NOW, AS ALWAYS, THE ACME OF *EFFICIENCY, UNIFORMITY, ECONOMY,* AND EVERY STEEL MILL ELECTRICAL MAN SHOULD EXAMINE THEIR MERITS AND ECONOMY NOT ONLY FOR LARGE AND IMPORTANT MACHINES BUT ALSO FOR GENERAL PURPOSE AND AUXILIARY MOTORS.

LE CARBONE AIR DEPOLARISED DRY CELLS, A NEW PRODUCT, ARE AS GREAT AN ADVANCE IN THE ART AS WERE LE CARBONE BRUSHES. FOR PYROMETERS AND APPLICATIONS WHERE

STEADY VOLTAGE UNDER LOAD
LONG SHELF LIFE
LOW WEIGHT PER AMPERE HOUR
AND LOW COST PER AMPERE HOUR ARE DESIRED

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ANNOUNCING

A NEW METHOD OF ANNEALING SHEETS

GUARANTEES UNIFORM ANNEALING

—+—

ELIMINATES FURNACES

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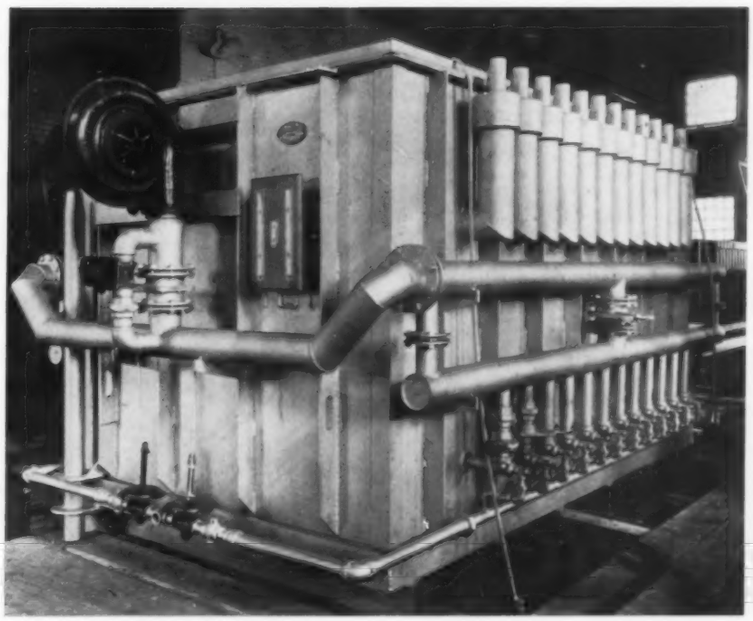
LONG LIFE AND LOW MAINTENANCE

—+—

AUTOMATIC TEMPERATURE CONTROL



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—+—

SHORT CYCLES

—+—

LOW FUEL COST

—+—

AUTOMATIC ATMOSPHERE CONTROL

A WILSON ANNEALING COVER AND BOTTOM

LOW FIRST COST

AN EXCLUSIVE DEVELOPMENT OF

THE LEE WILSON ENGINEERING CO.

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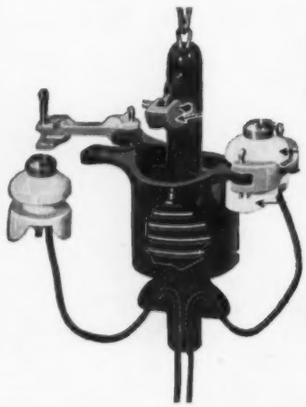
ANOTHER IMPROVEMENT IN THOMPSON LAMP LOWERING HANGERS

—provides for wiring lower contact-elements to the reflector instead of building them into the lower member of the Hanger—quick and easy installation—reflectors interchangeable without re-wiring. Contact-elements securely fastened in holders, yet readily demountable without disturbing wiring connections—permits socket repairs to be made in shop where suitable facilities are available.



Gravity Toggle Suspension Fitting No. 137 makes Hangers and Lamps self-aligning in vertical position, when attached to irregular overhead support.

Still Another Improvement—hereafter the iron latching parts in all THOMPSON HANGERS will be Cadmium plated, for protection against corrosion.

GET PRICES ON THESE NEW DEVELOPMENTS.

THE THOMPSON ELECTRIC CO.

1101 Power Ave., N. E. Cleveland, O., U. S. A.
Note New Address

$500,000,000.00

IN THE LAST FIVE YEARS THE EXECUTIVES WHO READ

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have assisted in the purchase of more than $500,000,000.00 worth of Mechanical, Electrical, Lubrication, Combustion, Safety and Welding Equipment and Maintenance Materials used in the Iron and Steel Industry.

USE THE IRON AND STEEL ENGINEER TO REACH THESE EXECUTIVES

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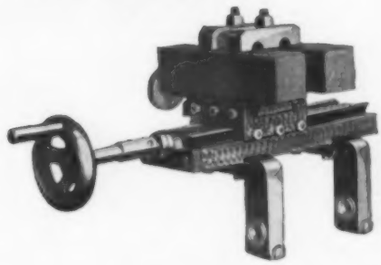
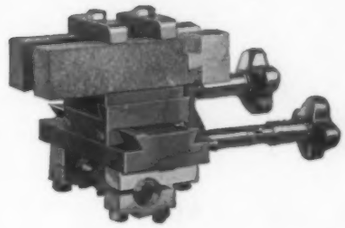
COMMSTONES AND COMMUTATOR GRINDERS

Made under U. S. Pat. No. 1,660,316





Write us for New No. 18 Catalog—Many New Products.

Be sure to call at our Exhibit Booth No. 92 Iron and Steel Exposition, Cleveland Public Auditorium, Sept. 18-20 inc.

The Martindale Electric Co.

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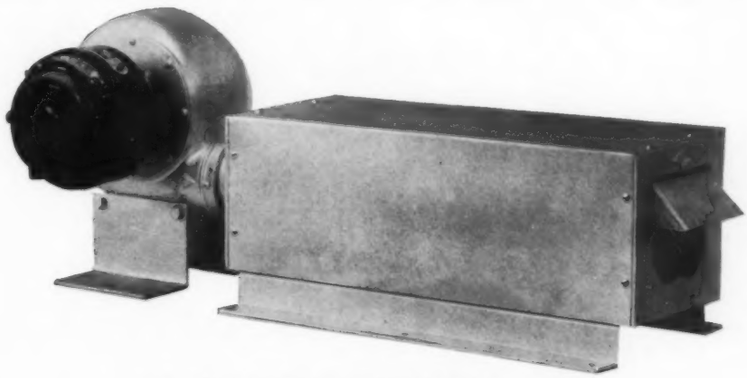
CLEVELAND, OHIO, U. S. A.



B-L 90 Heating and Ventilating Unit (Crane Cab)

N-L

Crane Signal (Double No. 80)

Write for the new E-3 Catalogue of N-L Products, just off the press.

Complete descriptions of the B-L 90 Heating and Ventilating Unit, Universal and Glowlite Lanterns, and the Lintern Electro-Magnetic Sander for overhead cranes, are included. Make sure of your copy by writing today.

THE NICHOLS-LINTERN COMPANY

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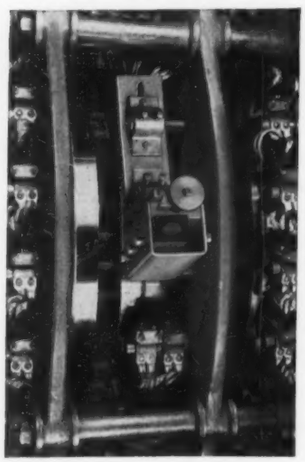
In Canada: Railway & Power Engr. Corp., Ltd., Toronto.

SEE THESE TIME AND MONEY SAVING MAINTENANCE TOOLS

at the Cleveland Exposition

the new **IDEAL** "LUFT" MODEL RING GRINDER

and hosts of others . .



You've probably heard a lot about the many new "IDEAL" products. Here's a chance to see them displayed—see them actually demonstrated.

Make a note of our booth number—23—and be sure to make it one of your first stops at the show. You'll find the following new products interestingly displayed:

Collector Ring Grinders
Commutator Grinders
Coil Winder Head
Brush Seater (for Carbon, Graphite and Metal Composition Brushes)
"Jumbo" Super Powered 3 in 1 Blower, Suction Cleaner and Sprayer
Hand Type Mica Slotter
Combination Test-Lite and Fuse Puller
Perfect Seal
Kant-Rust Lubricant
Portable Electric Drill
Portable Electric Grinder

There is an unusual "performance" story on each one. The Luft Model Ring Grinder illustrated above, for instance, trues rings in their own bearings—at normal operating speed—WITHOUT DISASSEMBLY. It saves the excessive cost of labor and shutdown delay in disassembling and reassembling—and accuracy to 1/000 of an inch is a common experience.
If you JUST CAN'T make the show this year, do the "next best" thing—send the coupon below for the complete story on the money-saving IDEAL line.

IDEAL COMMUTATOR DRESSER CO.
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1045 Park Ave., Sycamore, Ill.
Gentlemen: Please send me information on the following:
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Firm Name.....
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Visit our booth..103

•

A cordial invitation to visit our plant is also extended

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THE OHIO CARBON COMPANY

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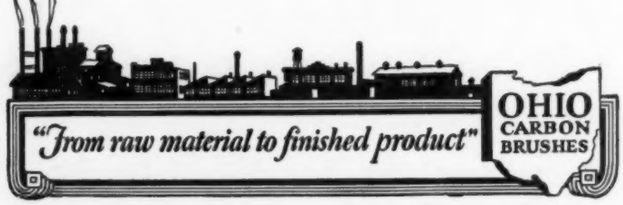

KEYSTONE
CONTACT RAIL EQUIPMENT
FOR CRANES

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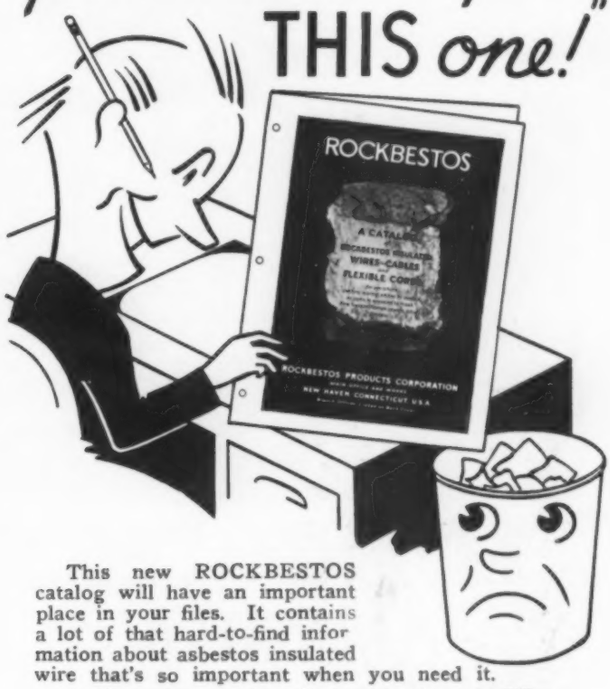
Manufactured by
ELECTRIC SERVICE SUPPLIES CO.
17th and Cambria Streets, Philadelphia
Branches in principal cities

"You'll never get THIS one!"



This new ROCKBESTOS catalog will have an important place in your files. It contains a lot of that hard-to-find information about asbestos insulated wire that's so important when you need it.

It illustrates and describes more than 40 different types of asbestos insulated wire, cable and flexible cord—everything from heatproof lighting fixture wire up to a 2,000,000 circular mil power cable, all with asbestos or A.V.C. insulation and many of them catalogued for the first time.

It shows all the different wires which ROCKBESTOS has developed for special purposes—motor lead cable, thermostat control wire, switchboard wire and hinge cables, heavy duty heater cord and even a new industrial heating cable which can be used as freeze prevention on sprinkler systems.

It tells how to select and install these wires, either in conduit or open, under conditions of heat, fumes, oil, grease or fire hazard, and explains why they will operate satisfactorily where ordinary wires fail.

Every man responsible for electrical maintenance, every engineer who writes wire specifications, every electrical draftsman—ought certainly to have a copy of this new catalog and handbook.

It's free. The coupon will bring you one. There's no obligation. Write or mail the coupon right now. Address ROCKBESTOS PRODUCTS CORPORATION, 71 Nicoll St., New Haven, Conn.

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—the wire with permanent insulation

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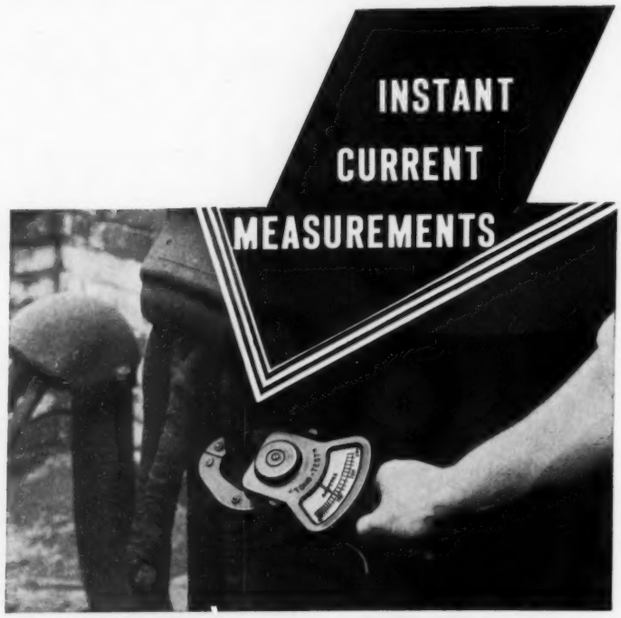

"TONG TEST" AMMETERS

will make any A.C. or D.C. reading in five seconds, without breaking the circuit or interrupting operations. Compact, light in weight and accurate, Tong Tests are made in the following sizes:

Type A— 50, 100, 150, 200 amperes.
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Type C— 75, 100, 200, 300, 400, 600, 800 amperes.
Type D—100, 200, 300, 400, 600, 800 amperes.

Type A, price $75.; Types B or C, price $85.; Type D, price $95.
(These prices cover "tongs" and any two scale-range elements for the type selected.)

Periodic current measurements are essential to economical operation. The "Tong Test" Bulletin describes how much faster, easier and cheaper these check-ups can be made with this remarkable instrument. Write for a copy.

THE COLUMBIA ELECTRIC MFG. CO.

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"TONG TEST"

Gentlemen:
I would like to know how much easier and faster "Tong Test" will make current measurements. Without obligation, please send me a copy of the "Tong Test" Bulletin.

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Mean Many Wasted Dollars

The true story of the waste caused by dripping leaking oil can be read all over your plant, in the puddles and pools on and under machines.

Oils that leak cannot lubricate dependably, they must be applied frequently and cause high application cost.

NON-FLUID OIL — "The Modern Lubricant" — does not drip or leak, but "stays put" in bearings. It lubricates constantly and dependably until entirely consumed, outlasting liquid oil 3 to 5 times, thus reducing both lubricant cost and cost of application.

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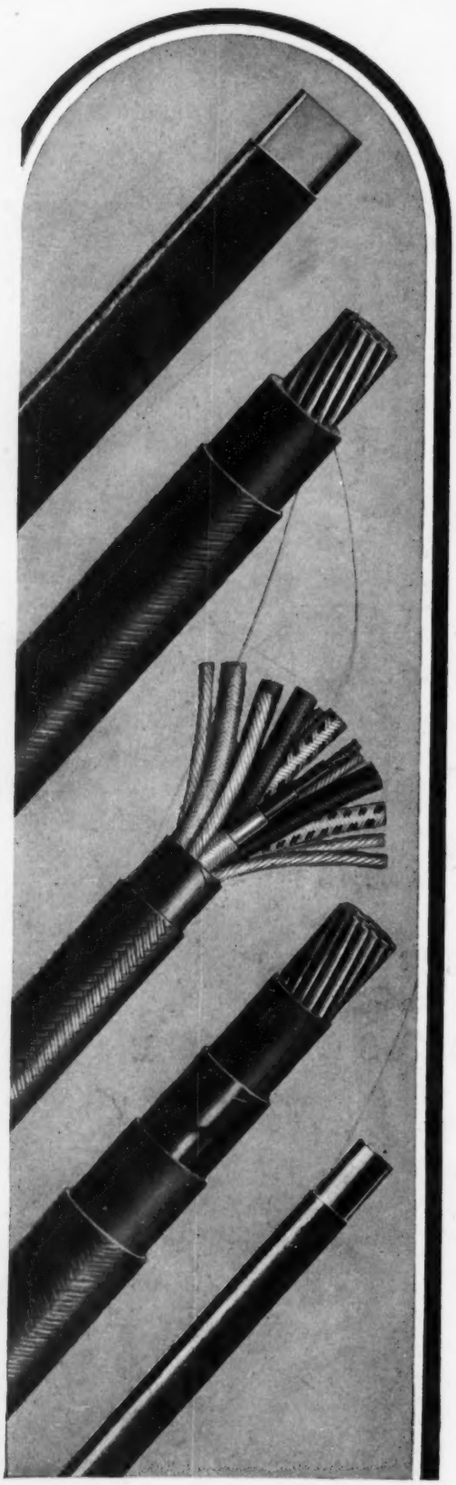

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ASBESTOS-INSULATED WIRES FOR EVERY PURPOSE

General Electric manufactures a complete line of Deltabeston Asbestos Insulated Wires and Cables. They are made of the highest-quality materials and by a unique process. The high percentage of inorganic material contained in the insulation assures maximum resistance to heat. For that reason, Deltabeston Wire is unexcelled in performance where heat is a factor. The illustrations show a few Deltabeston Wires and Cables particularly suitable for application in the iron and steel industry.

Constant research and experimentation are being made in the effort to improve their quality and performance. For information on the complete line of Deltabeston Asbestos Insulated Wires and Cables see your G-E Merchandise Distributor or Graybar Electric Co., or write Section Y-249, Merchandise Department, General Electric Co., Bridgeport, Connecticut.

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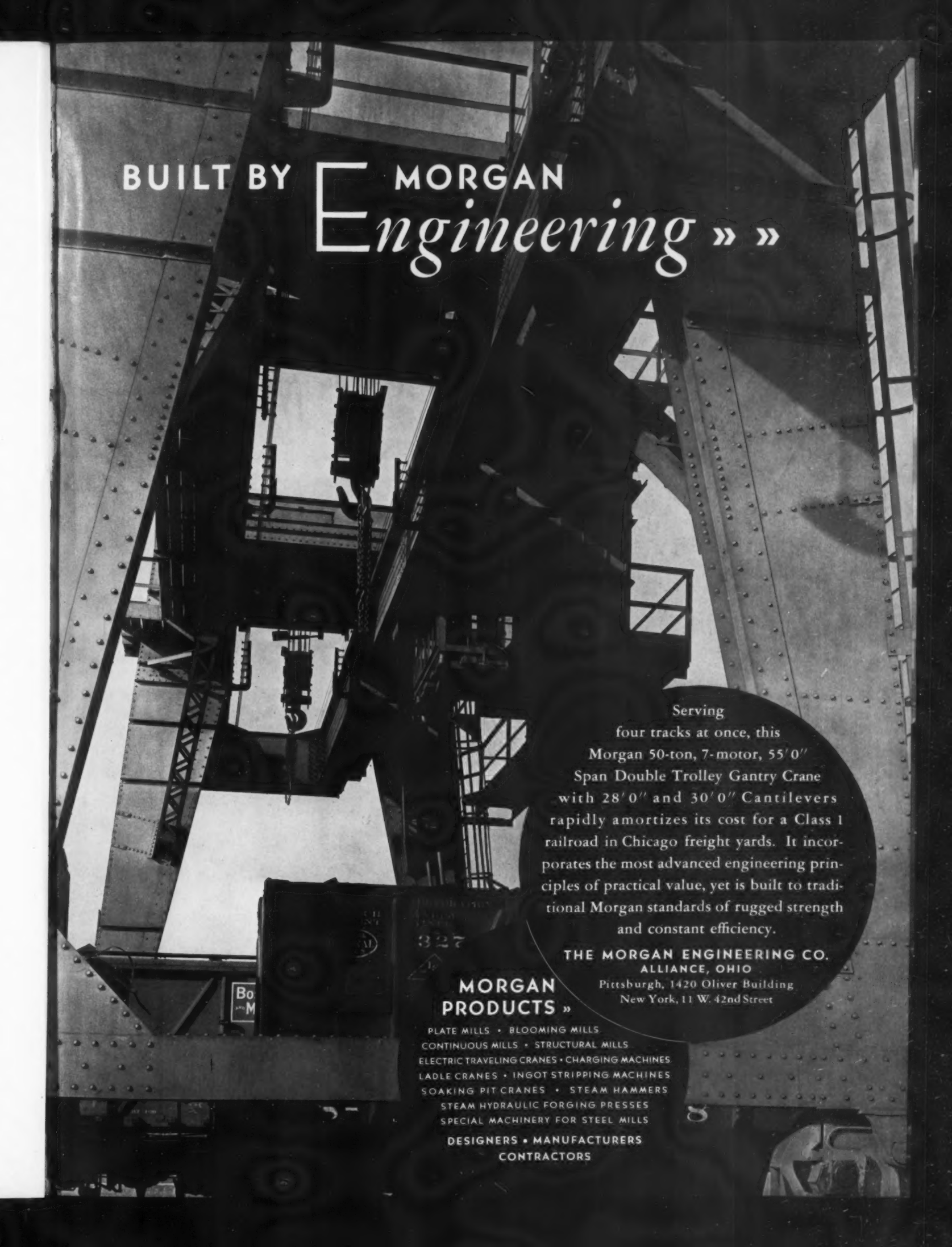
DELTABESTON WIRE AND CABLE

MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT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Morgan 50-ton, 7-motor, 55′0″
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LADLE CRANES • INGOT STRIPPING MACHINES
SOAKING PIT CRANES • STEAM HAMMERS
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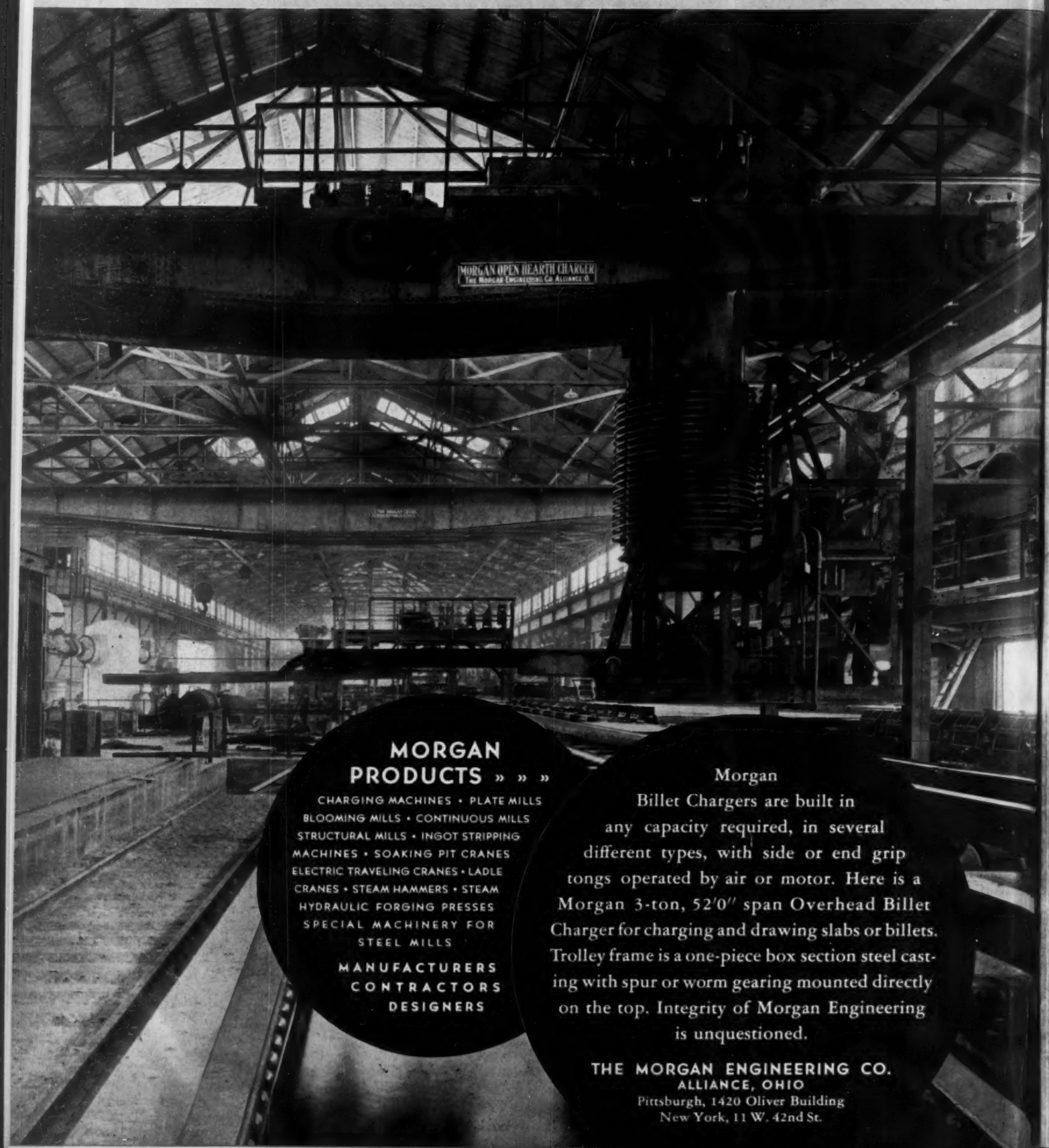

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MACHINES • SOAKING PIT CRANES
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SPECIAL MACHINERY FOR
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MANUFACTURERS
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DESIGNERS

Morgan Billet Chargers are built in any capacity required, in several different types, with side or end grip tongs operated by air or motor. Here is a Morgan 3-ton, 52′0″ span Overhead Billet Charger for charging and drawing slabs or billets. Trolley frame is a one-piece box section steel casting with spur or worm gearing mounted directly on the top. Integrity of Morgan Engineering is unquestioned.

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ALLIANCE, OHIO
Pittsburgh, 1420 Oliver Building
New York, 11 W. 42nd St.

BUILT BY MORGAN
Engineering » »
Several
of these Morgan Screw
Type Strippers are in use in
large steel plants, performing at
full efficiency and capacity, year in,
year out. As shown, this Morgan ingot
stripper is arranged for stripping big end up
ingots with hot tops, one of the three
distinct stripping operations it will handle
efficiently. It can be quickly changed over to
handle small end up or regular type ingots,
as illustrated on following two pages.
MORGAN
PRODUCTS » » »
INGOT STRIPPING MACHINES
CHARGING MACHINES • PLATE MILLS
BLOOMING MILLS • CONTINUOUS MILLS
STRUCTURAL MILLS • LADLE CRANES
ELECTRIC TRAVELING CRANES
SOAKING PIT CRANES • STEAM HAMMERS
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Pittsburgh, 1420 Oliver Bldg.
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Typical

MORGAN OVERHEAD

for performing three o

Fig. No. 1—Strippi
Fig. No. 2—Strippi
Fig. No. 3—Breakin

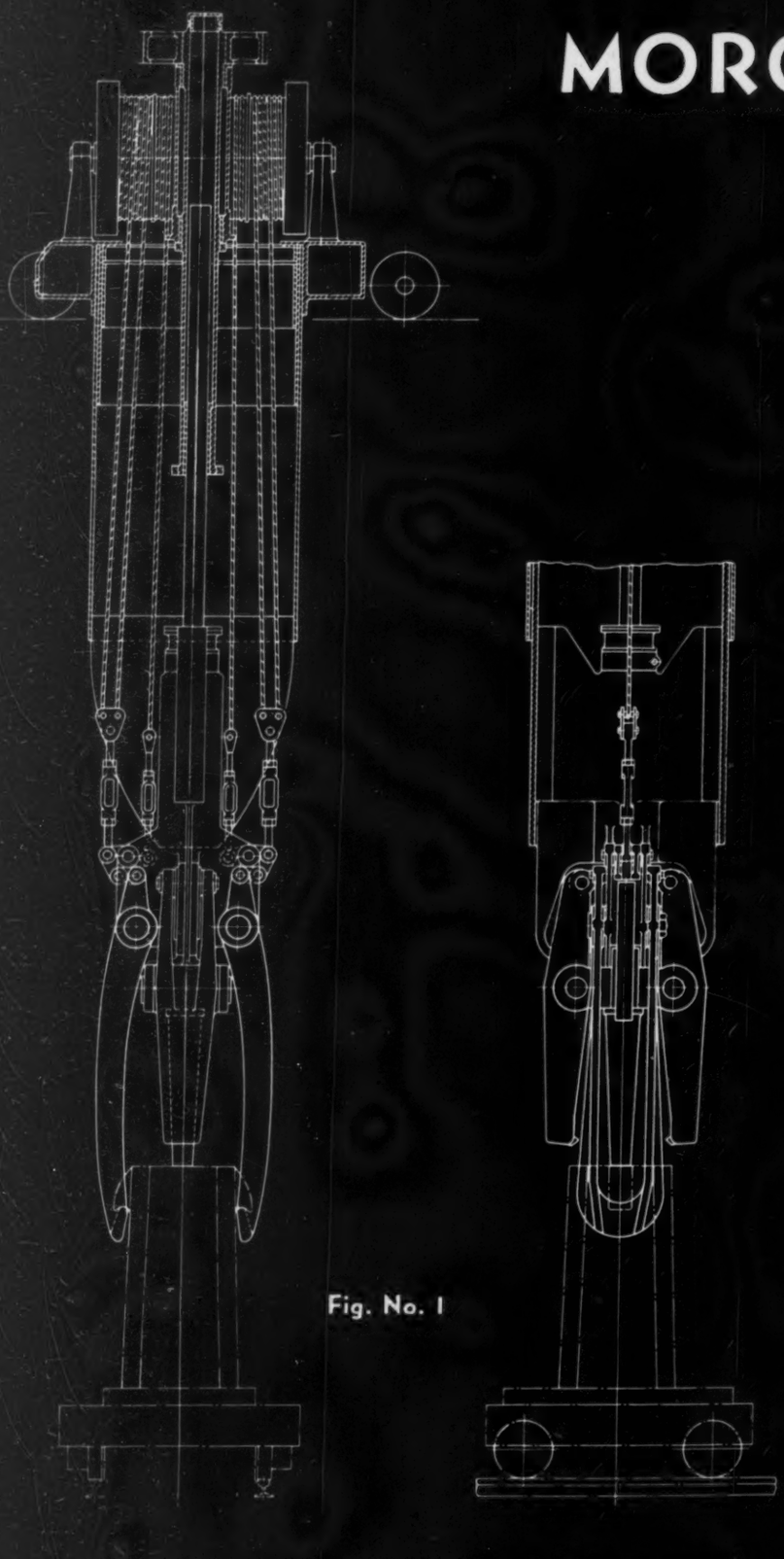


Fig. No. 1

Fig. No. 1—Stripper arranged for stripping small end up or standard ingots. This is accomplished by inserting a standard bull nose into a recess in the ram, in which case the bull nose is used to hold the ingot in place on the car and the regular links are used for stripping the mold from the ingot.

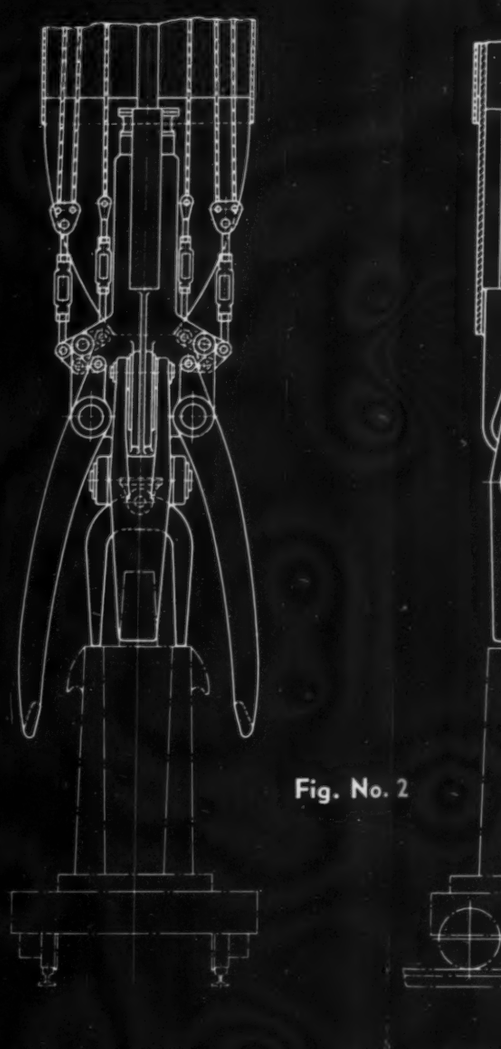


Fig. No. 2

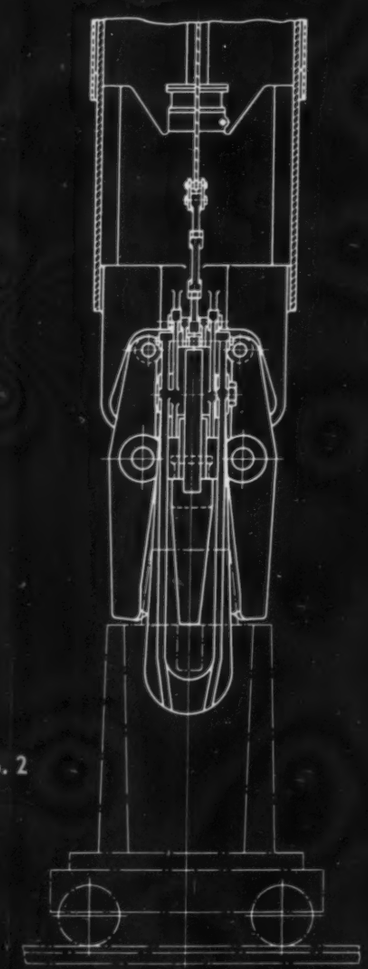
Fig. No. 2—Stripper arranged for stripping bi
bull nose as illustrated in Fig. No. 1 is remov
casting inserted in its place, for holding the
car and the gripping tongs are then used
ingot from the mold.

ypical arrangement layout of a

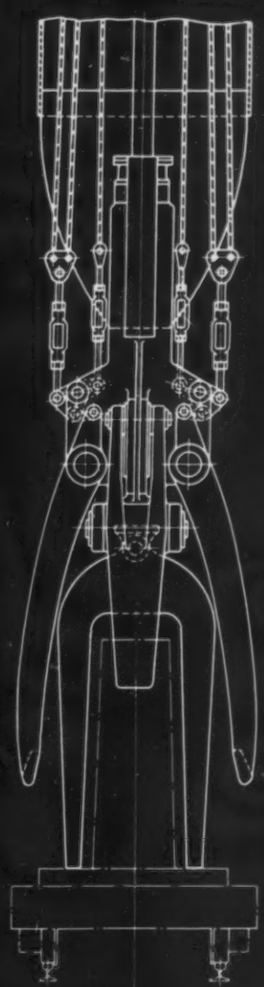
AD SCREW TYPE INGOT STRIPPER

three distinct stripping operations as follows:

Stripping small end up or standard ingots
Stripping big end up ingots
Breaking small end up ingots loose from stools



No. 2



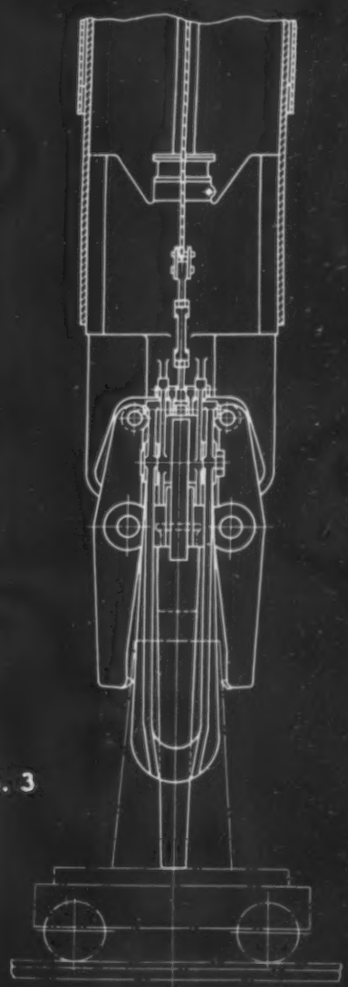


Fig. No. 3

for stripping big end up ingots. The No. 1 is removed and a horse shoe or holding the mold in place on the are then used for withdrawing the

Fig. No. 3—Stripper arranged for loosening small end up or standard ingots from the stools after the molds have been removed.

This operation is accomplished by removing the bull nose required when stripping small end up ingots and inserting the special horse shoe casting in its place. The horse shoe casting is used for holding the stool down in place, while the gripping tongs raise and break the ingot loose from the stool.

BUILT BY MORGAN *Engineering* » »

Huge, able servants of the steel industry, these two Morgan-built machines are typical of the usual equipment to be found in the plants of the largest steel producers. Evidence of the practical value of six decades of Morgan Engineering integrity is found in both the Morgan 100-ton, 4 girder, 78′6″ span hot metal charging crane and the Morgan 5-ton, 24′6″ span low type floor charger, in constant use.

THE MORGAN ENGINEERING CO.
ALLIANCE, OHIO
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INGOT STRIPPING MACHINES
STEAM HYDRAULIC FORGING PRESSES
SPECIAL MACHINERY FOR STEEL MILLS

DESIGNERS
MANUFACTURERS
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Structural shapes up to 24″ I-beams and 8″ x 8″ angles are rolled on this Morgan 28″ structural mill, shown in operation. Mill consists of two 3-high stands and one 2-high stand; and was built complete with Traveling Tilting Tables, Runout Tables, Transfer, Straighteners and Hot Beds by Morgan Engineering. Morgan has designed and built complete a number of structural mills for important steel producers well acquainted with the certain dependability of any steel mill equipment produced by Morgan experience.

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LADLE CRANES • INGOT STRIPPING MACHINES

DESIGNERS • MANUFACTURERS
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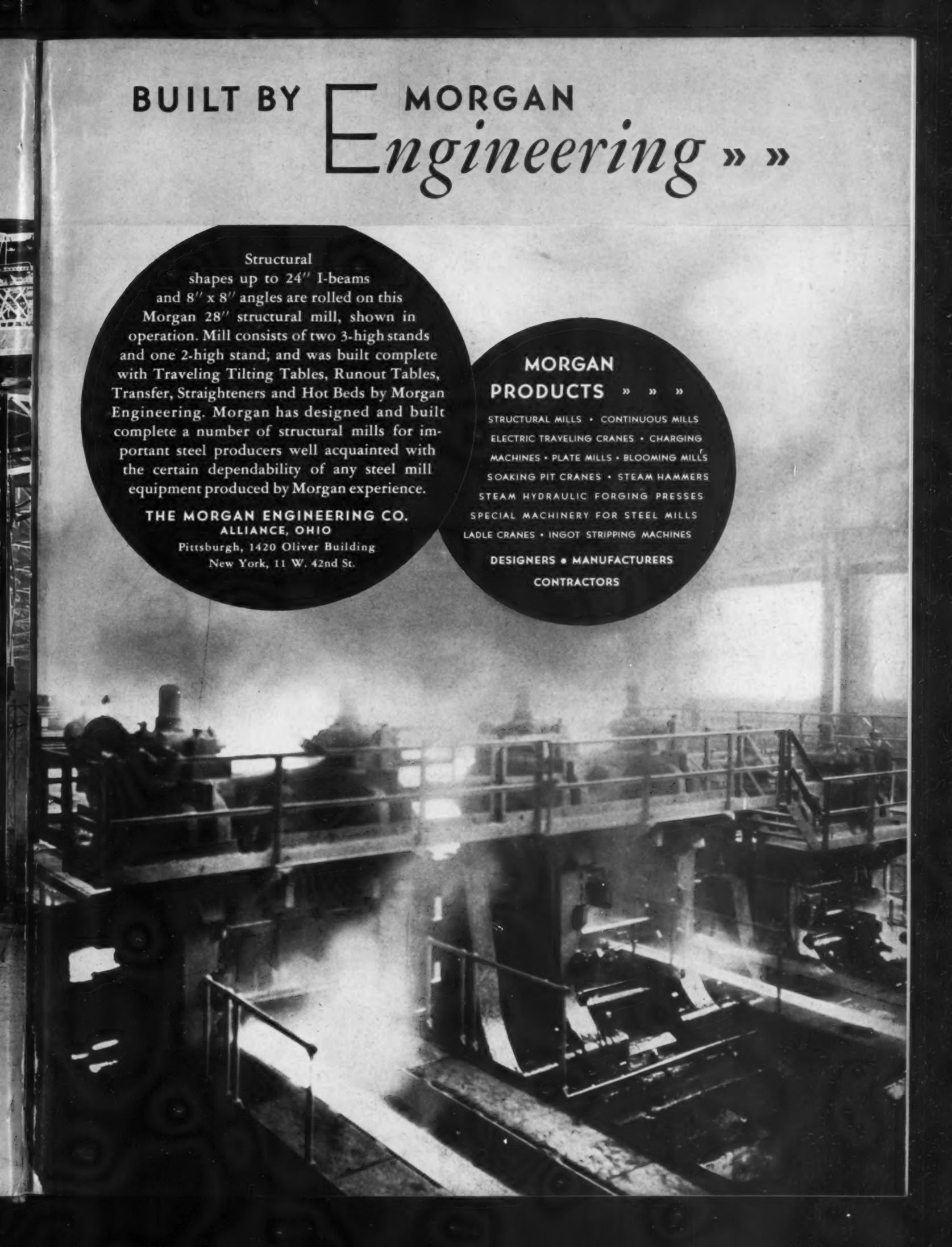

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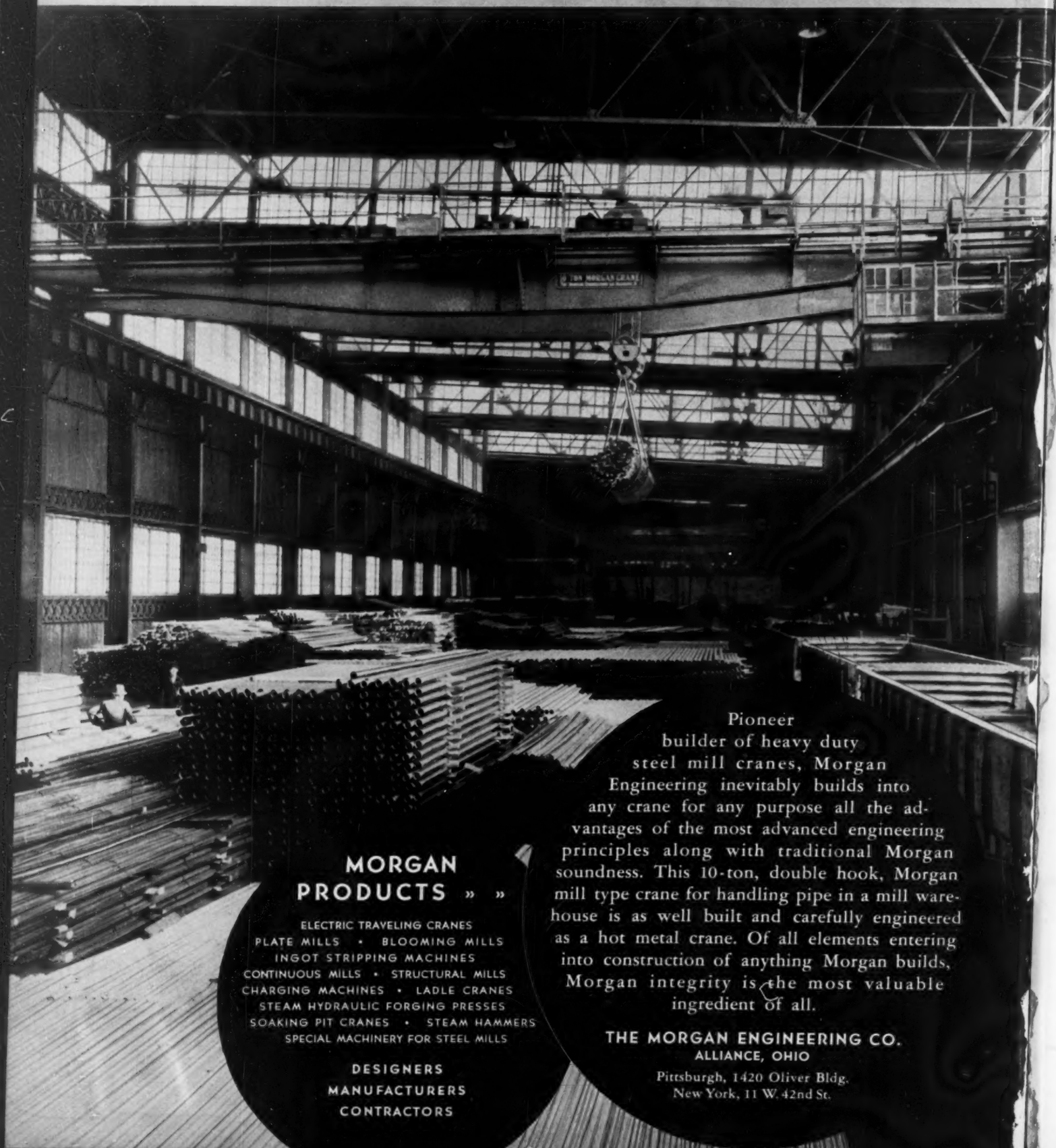

Pioneer builder of heavy duty steel mill cranes, Morgan Engineering inevitably builds into any crane for any purpose all the advantages of the most advanced engineering principles along with traditional Morgan soundness. This 10-ton, double hook, Morgan mill type crane for handling pipe in a mill warehouse is as well built and carefully engineered as a hot metal crane. Of all elements entering into construction of anything Morgan builds, Morgan integrity is the most valuable ingredient of all.

MORGAN PRODUCTS » »

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INGOT STRIPPING MACHINES
CONTINUOUS MILLS • STRUCTURAL MILLS
CHARGING MACHINES • LADLE CRANES
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